Climate change challenges and the search for a sustainable policy

Unity of
fitness for Purpose, Polluter-pays principle
& level Playing field

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I Introduction

Early 2005 two historic events concerning climate policy occurred: the world's greatest scheme of emissions trading started in the European Union on the 1st of January; the second event was the Kyoto protocol coming into force on 16 February. The latter makes the agreed targets of Annex 1 countries binding for the compliance period 2008-2012.

By the end of 2004 discussions started about the possibilities for post 2012 policies. A sector-based approach was discussed at COP-10 as an option for climate policy.

The EU Directive implementing emissions trading distinguishes two trading periods: a three-year period 2005-2007 and a five-year period 2008-2012. The possibilities for change for the second period seem to be limited because the National Allocation Plans (NAPs) need to be ready again by mid 2006. Nevertheless there should be significant scope for improvement as the first period was always recognised as a learning-by-doing period.

This paper outlines the technology challenges and policy challenges that lay ahead when concrete results need to be achieved for climate change. The difficulties of current climate policies for European industries are analysed leading to a proposal for a more sustainable approach. It is argued that such an approach will be one of the keys to get newly industrialising nations aboard.

II History of a successful change

II.1 How we might look back from 2030?

Imagine we are living in the world of our grandchildren – around 2030 – and imagine that the world community has been successful in making drastic changes to the total economy with regard to climate change. What could be the history of this successful change?

II.2 Political views beginning 21st century

In the beginning of the 21st century there were intense debates about climate change and the policies that would need to be adopted. Increasingly the perception grew that climate change was a potential threat to our way of life and that concrete steps needed to be undertaken.

However climate change policies were far from coherent around the world. When the Kyoto protocol came into force, the nations bound by this treaty adopted absolute caps as their policy focus. In the European Union this approach was translated into a policy for companies by an emissions' trading scheme.

USA rejected this policy stating that climate change caused through greenhouse gas emissions induced by human activities was not proven. In addition damage avoidance to their economy and their way of life was mentioned, but in retrospect it was also for a gut feeling that the USA did not like the adopted policy.

At the time the economic growth of developing giants such as China was formidable. The developing nations – notably China, India and Brazil – were involved in the climate debates. They also had great difficulties to adopt the approach that had been actively promoted by the leadership of the European Union.

Although an absolute lowering of greenhouse gas emissions was needed when accepting a precautionary policy for climate change, the question was whether absolute targets for nations as well as for companies would be the right policy. This was called the riddle of absolute caps.

II.3 The riddle of absolute caps

Finally the riddle of absolute caps was disentangled by the answers to a limited number of key questions, which emerged between heads of state and captains of industry. These questions were:

- Would acceptance of an absolute cap be responsible behaviour for a developing nation?
- What scientific method exists for establishing such a cap for a nation or a company?
- What is the influence – more precisely the difference – of actor decisions on climate change between building a new installation in country A or B?

These rhetoric questions led the way to an alternative policy approach.

II.4 Shaping a carbon constrained economy

Soon there was consensus that in a carbon constrained world sustainable progress was needed in all fields that contribute to the mitigation of climate change:

- Energy efficiency
- Carbon sequestration (capture & storage)
- Biomass
- Renewables
- Nuclear (inherently safe & fusion)

No single solution was believed to curb greenhouse gas emissions. Leaving coal and lignite was not seen as a realistic option. Therefore carbon sequestration was adopted as an intermediate solution for the 21st century. Neither giving up nuclear was perceived to be realistic; making the change to an absolute lowering of emissions would become even more difficult.

Absolute lowering of greenhouse gas emissions while maintaining stability and growth of global welfare was seen as the immense challenge ahead.

II.5 The world of our grandchildren

Around 2030 a drastic change was achieved indeed. The achievements are summarised:

- Welfare growth of 50%
- Energy efficiency improvement of 40%
- Penetration of carbon sequestration of 30%
- Biomass economy of 20%
- Comeback of other renewables
- Hydrogen as an upcoming energy carrier

Resulting in:

- Greenhouse gas emissions down with 35%

Energy efficiency improvements were realised in all sectors (buildings, industrial installations, transportation) and there is still momentum and potential for further improvements. Breakthroughs in carbon capture technologies were realised and international pipeline grids for CO_2 were established. Clean coal plants became a reality assuring a 2nd lifetime for coal using immense reserves.

Biomass is playing a growing role as raw material and as energy carrier. It proved to be a new impulse to the co-operation between industrialised and industrialising nations. Much progress is achieved with sustainable plantations and with the implementation of concentrating technologies in Asia, South America and also Africa. The use of biomass as added fuel in transportation as well as co-firing coal plants for electricity served as a trigger for development.

Other renewables – such as wind, solar, geothermal and tidal – were recognised to be rather expensive if compared to energy efficiency, carbon sequestration and biomass. Generally subsidies for implementation were cut and attention shifted to research and development. This posed an enormous challenge to the industries involved, which led to a new generation of renewable technologies. Solutions were an order of magnitude cheaper and therefore renewables are making a remarkable comeback.

Hydrogen was for a long time an eternal promise. But finally it is appearing as an upcoming energy carrier. The main inroads became the storage function for cheaper renewables with supply fluctuations.

II.6 Which steps were undertaken?

Legislators undertook policy changes that can be summarised as follows:

- Innovation as priority 1
- Kyoto targets changed in nature
- One standard for electricity
- Fundamental obstacles of CDM[1] removed

Emissions' trading on a global scale was adopted as a major driver. The reasons: to proliferate targets to individual actors and to provide an incentive for improvement.

Innovation was clearly recognised to be crucial to address the climate change challenge. It was in the air in Europe – a clean, clever and competitive approach under the Lisbon strategy – as well as in the USA – where technology was recognised as the main solution. The same was true for Asia where many plants were being build, which would last for 30-40 years making the challenge to mitigate climate change very difficult.

These perceptions became the major driver to intensify the development and implementation of innovative technologies.

The economic incentive from emissions trading proved to be insufficient for the development of innovative technologies. Therefore additional support schemes emerged.

The Kyoto targets changed after some time in nature: absolute targets were abandoned. Worldwide sector and products targets based on efficiency developed. This started with initiatives from industry leaders and associations with voluntary agreements in various industries (aluminium, cement, steel, chemicals, etc.). In the trading schemes allowances were coupled to the realised production of goods for society, to standards per unit of product that became harmonised globally.

[1] Clean Development Mechanism.

This meant for electricity one standard. One standard for electricity based on coal, lignite, natural gas, biomass (full or for co-firing) as well as renewables. Without this single standard it appeared not possible to combine the carbon constraint while maintaining coal as a major energy carrier, the latter by carbon sequestration leading to clean coal plants and by extensive co-firing of biomass in existing installations.

Combined Heat & Power (CHP) got a better policy basis with a clear and stable incentive and became the standard where industry needs heat. The use of natural gas shifted from stand-alone combined cycle plants to CHP.

CDM – project mechanism for developing nations – started promising but the early rules turned out to be major obstacles. CDM credits are raised when the performance of a project undertaken – note the relation to efficiency and not to a predetermined cap – is better than a baseline. The baseline compared to national environmental policy was vague in itself – what is the baseline in case of further similar projects – and this also resulted in different baselines for the same type of projects in different countries.

The CDM board struggled with these obstacles, which meant enormous delays and uncertainties for developing sustainable projects. The obstacles were removed by adopting a new approach with harmonised standards – which became a growing list.

These policy changes paved the way for concrete actions by industrial actors:

- Inefficient plants undertook investments to reduce greenhouse gas emissions or were closed earlier. Production shifted from closed inefficient plants to efficient plants, new or existing;
- Development and implementation of innovative technologies in existing and new plants by rewarding front runners and additional support;
- Fast growth of gas for CHP coupled to industrial use of heat;
- Co-firing of biomass on existing coal plants and clean coal plants with carbon sequestration emerged on a significant scale.

III Where we are today: Cap & Trade

Climate change mitigation poses technology as well as policy challenges. These challenges need to be analysed in more detail in order to identify effective responses.

III.1 Technology challenges

From the viewpoint of climate change, following main technology opportunities are so many challenges to be met:

- Great improvement potential of most processes
- Intensified carbon capture technologies
- Wind, solar and other renewables

Most processes have still an exergy efficiency of only 10%-20%. Ultimately energy efficiency improvements by novel technologies are cheap, but this takes much lead-time (for example in buildings) and great efforts in development. The path from development to implementation needs not only high costs and but certainly also risk taking (industrial processes, new transportation technologies).

Acceleration is needed if important results are wanted for the coming decades. Frontrunners must be rewarded with emission allowances in favour of more polluting processes and above that special support schemes are needed. In this way an important inhibitor can be overcome: to apply proven technology when revamping existing installations or when building new plants.

Carbon sequestration is very promising but capture technologies need to be further developed to achieve a total cost for clean coal plants of € 20-25/ton CO_2. Conventional technologies based on amine adsorption are too expensive. Novel intensified processes, for example with "higee separators", might turn out be a new way.

Renewables like wind and solar need further vigorous development, towards a much lower cost price, when a significant contribution is desired. Currently wind energy needs a subsidy of the equivalent of € 100-150/ton CO_2 if all additional costs are included (extra grid costs, back-up capacity). Solar is probably a factor 2-3 more expensive.

The lead-time of the desired developments is significant, as a rule of thumb at least 10 years. Therefore adequate policy changes need to be considered today.

III.2 Policy challenges

Current policies face a number of challenges, which need to be addressed:

- Immense support (subsidies) for renewables
- Emissions trading as started by the European Union
- The challenge to get the remainder industrialised and industrialising nations aboard

The current high cost support schemes for renewables encourage an ill-considered and overzealous fast growth. There will be regret when later lower cost solutions can be achieved. Therefore a shift to less implementation and more research & development is needed; with the target of significant lower cost-prices.

Emissions trading in the European Union – the centrepiece of policy for industrial emissions – started with the first round of allocations (in national allocation plans – NAPs). The trading scheme lost track of its purpose. The general picture is further elaborated in this study:

- Disincentive to close inefficient plants and shift production to existing or new plants; obsolete plants are kept alive longer than without emissions trading.
- No or limited incentive to develop and implement innovative technologies in existing or new plants; frontrunners are most often not rewarded.
- Virtually no incentive for CHP (Combined Heat & Power).
- No long-term certainty for co-firing biomass and complete failure to support clean coal.

Climate change is a global problem; therefore a global approach is required. Discussions have been started to come to a concerted approach worldwide. However, the mindset of the European Union is very much to go on with the current Kyoto approach and to expand the emissions trading scheme as it is today over the globe (Norway, Canada, Japan, South Korea, USA, etc.). This mindset is further discussed and is argued to be the major obstacle to achieve agreement for sustainable policies.

Key to the current mindset is the theory that absolute caps are necessary to achieve sustainable results. For emissions trading – both for nations as for companies – this approach is known as cap & trade. This theory is tested below mentioning primarily companies as actors.

III.3 Testing the assumptions of the cap & trade theory

In scientific (economic) literature advocates of cap & trade argue that it is a superior system compared with a system based on relative targets, notably PSR[2]. With PSR the amount of allowances is coupled to the realised production of goods for society, whereas in cap & trade allowances are uncoupled to production but based on historic emissions (production).

The quoted assumptions in favour of cap & trade are:

- Certainty of the environmental outcome
- Necessary or better for market liquidity
- Lower transaction costs
- Necessary or better to provide certainty for investments to reduce emissions

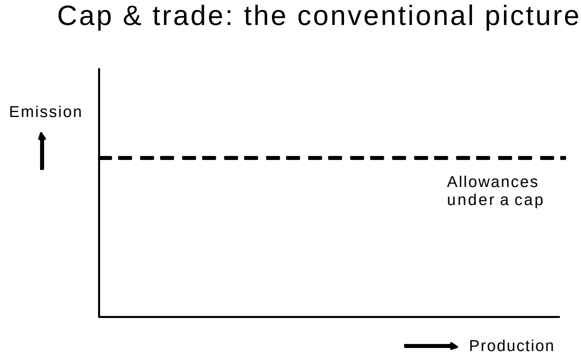
It will be demonstrated below that these assumptions are not based on facts. In chapters III.7 and III.14 it is argued that the theory also fails for new entrants and closures.

III.3.1 Assumption: cap & trade gives certainty of the environmental outcome

The first argument is illustrated with the figure below:

It is claimed that the cap ensures that the targeted environmental outcome is met. There is no limit on growth as producers can purchase allowances.

In contrast, a system based upon relative targets is claimed to have no certainty of the outcome.

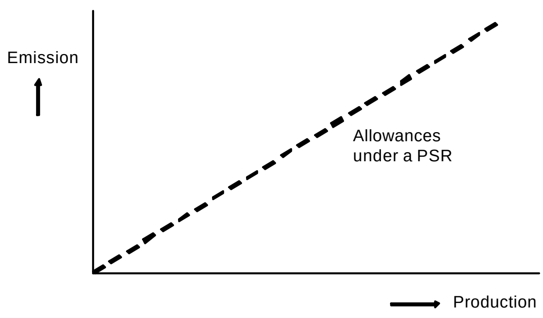


[2] Performance Standard Rate: an amount of emission allowances per unit produced.

By producing more, more energy is used and producers create allowances for themselves according to a PSR. Advocates of cap & trade illustrate this assertion by the next figure:

Unfortunately, the European Commission has taken this conventional wisdom for granted[3]. This had great consequences because the Commission insisted on cap & trade and forbid alternatives. The Commission allowed that historical grandfathering was used to grant allowances under a predetermined cap for individual companies for the first trading period 2005 up to and including 2007; this was applied in most Member States.

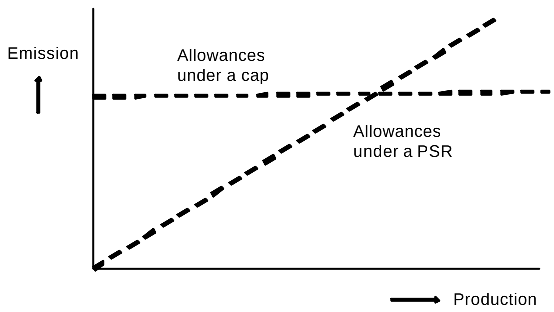
PSR: the conventional picture



In reality the environmental outcome is not as certain as it seems to be at first glance. If afterwards (ex-post) the industrial production – the total energy use – is higher than beforehand (ex-ante) forecasted, the emissions break through the desired environmental outcome – the cap. The normal laws of physics and chemistry still apply.

The desired overall cap for all participants can only be achieved if the economic growth and the weather (temperature, rain) are in the order of magnitude as expected beforehand and if the lead-time of projects to reduce emissions is taken into account. An expected margin is the capacity for fuel switch, shifting electricity production from coal plants to existing gas plants. This option has a limit: the spare gas capacity. Estimates of the fuel switch potential vary between 70 Mton/year and over 100 Mton/year, significant but still a small proportion of the 2150 Mton/year of the industry falling under emissions trading in the EU-25.

Reality of the combined picture
Emission breaks through cap if energy use > forecast

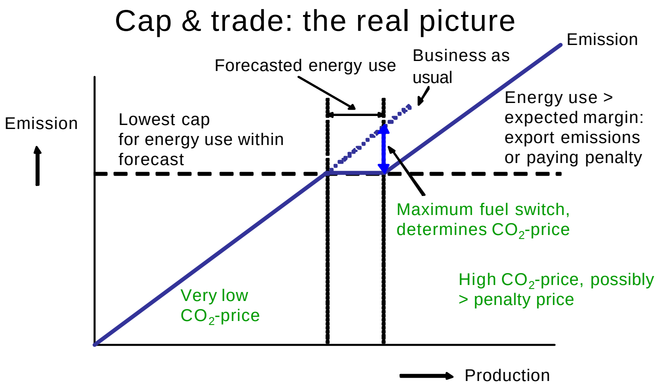


If however, the economic growth is higher than expected, the winters are colder, there is less rainfall (less hydropower) as usual and the potential for fuel switch is depleted, the actual emissions will break through the desired environmental outcome. As long as there is only trading in Europe, CO_2-prices will increase to the level that production will be shifted outside the European Union, which means exporting of emissions. If cap & trade would be applied globally, producers short of allowances are forced to pay the penalty price for non-compliance.

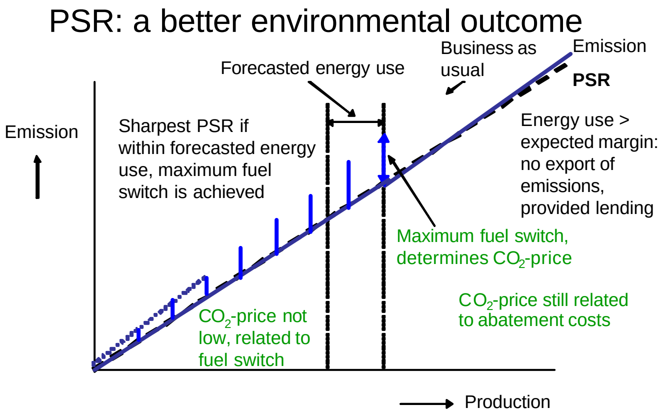
In the reverse situation prices may become very low and many years will be lost to fulfil what emissions trading was meant to be: to reduce emissions. Banking of allowances may then still maintain a certain price for CO_2.

[3] See for example Commission decision 24-06-2003, C (2003)1761fin, about the NOx trading scheme in the Netherlands which is based on a PSR approach.

In more detail, the reality of cap & trade looks as follows:



Careful analysis shows that a scheme with relative targets is more instead of less effective. This is illustrated below:



Also with the PSR system, the actual emissions will break through the desired environmental outcome if the economic growth is higher than expected, the winters are colder, there is less rainfall as usual and if the potential for fuel switch is depleted. In this respect both systems are on equal footing.

The latter figure clearly demonstrates that in the opposite case of lower economic growth, milder winters and more rainfall the PSR systems still works. The desired drive to promote reductions is maintained. In this respect the PSR system is superior to cap & trade.

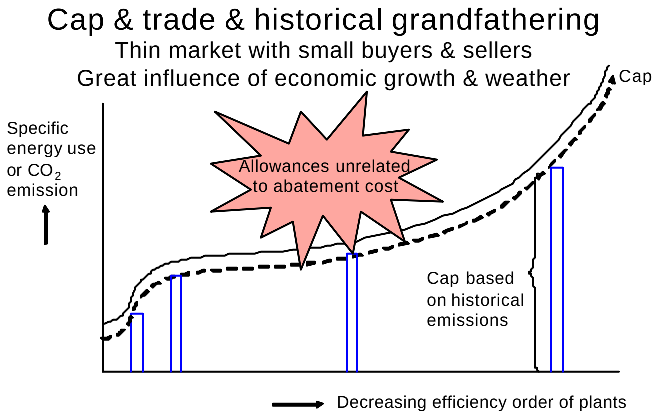
Conclusion environmental outcome

- The assumption that cap & trade gives certainty about the environmental outcome appears to be incorrect.
- At a lower economic growth than expected beforehand, PSR is superior to cap & trade.
- It will be demonstrated (in chapter III.3.4. and chapter IV) that PSR gives in any case a clear signal to undertake investments to reduce emissions.
- In conclusion, PSR is better instead of worse for the environmental outcome of the scheme.

III.3.2 Assumption: cap & trade is necessary or better for market liquidity

In contrast with conventional wisdom, the result with a PSR system is better market liquidity compared to a cap system. The market liquidity argument is further worked out in the next two pictures:

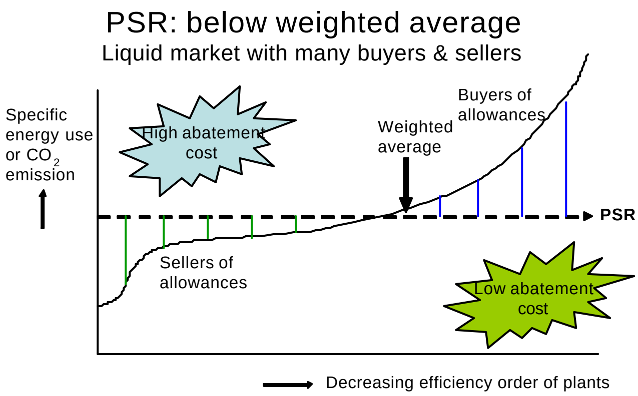
Under cap & trade caps are fixed for a longer trading period. The market is thin because lower economic growth than forecasted, less cold weather and more rainfall (more hydropower) exercise a significant influence on supply-demand and therefore will lead to a smaller market. Targets will not be exhausted and prices will remain irrelevantly low.



Emissions trading will be a poor stimulator to undertake emission reduction investments.

In a scheme with PSRs the situation is quite different:

There is great market liquidity as efficient plants become the sellers of allowances and inefficient producers must buy. The latter are stimulated to undertake investments to reduce emissions or to replace earlier less efficient plants with new state-of-the-art plants.



This approach complies with the aim of the EU Directive for emissions trading as stated in article 1 and recital 20 (to promote reductions and to promote energy efficient technologies). This allocation also complies with the “polluter-pays” principle; plants causing relatively high emissions get fewer allowances than their current emissions.

The weather and the exact economic growth have become of secondary importance. Market liquidity is maintained by a flexible approach[4] to the PSR and by adequate banking and lending. PSR is "recession-proof" and "weather-proof", better for climate policy.

[4] This is further elaborated in chapter IV.2 (cornerstones of PSR).

III.3.3 Assumption: lower transaction costs for cap & trade

Cap & trade
Data collection and verification were part of the transaction costs to make the allocation and to ensure annual compliance. The current approaches of cap & trade mostly use complex allocation formulas. The biggest debate was about the question: how representative is a historic reference period. It can be observed that the reference periods differ in all Member States.

Allocation formulas and reference periods lead to many negotiations, serious competitive distortions and to a great number of lawsuits. This adds up to the transaction costs.

In conclusion, the transactions costs for cap & trade are not negligible, but still bearable.

PSR
In the Netherlands PSRs based on energy efficiency were applied to reward early action but also to demand higher efforts from less efficient installations[5]. Together with a historical reference period (2001 and 2002) frozen caps were imposed on existing installations.

The PSR is the "worldtop" as defined under the Covenant Benchmarking[6]. In the Netherlands about 100 PSRs were established for different processes of a variety of industry sectors.

The typical costs for a benchmark are between € 25-40,000. This includes the cost for the independent consultant as well as company efforts; often the consultancy costs are shared between multiple companies with the same process. The total costs for 100 PSRs are therefore about € 2.5-4 mln.

A Verification Bureau verifies the method to be applied and the results. This bureau consists of about 10 persons (with industry experience), but they are also actively involved in data collection and the annual monitoring of efficiency and the annual verification of emissions.

Therefore as an indication € 5mln is attributed as additional costs to the use of PSR. This can be related to the allocation of allowances of a 5-year trading period, rounded upwards to 5 x 100 = 500 Mton for the Netherlands.

This means for the additional transaction costs of PSR: 5 / 500 ~ € 0.01/ton CO_2.

Conclusion transaction costs
The assumption that transaction costs are very much in favour of cap & trade appears to be incorrect. The additional transaction costs for PSR are already very low for a small country like the Netherlands. They will be lowered further in case of widespread use.

For running benchmark systems the cost are already very low today. In some cases only one phone call is sufficient to get data such as the European average and best practice.

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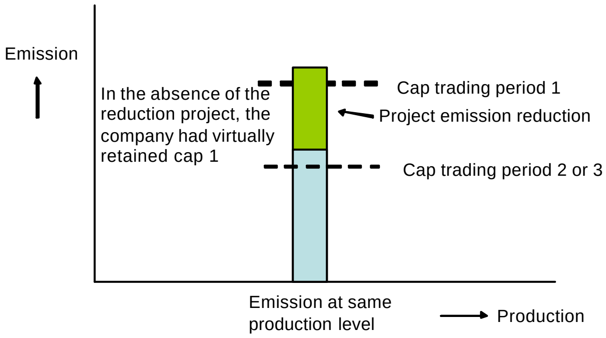
[5] The technical details pose severe limitations (minimisation and maximisation rule, the mathematic formula with the so-called beta-factor) which in itself (apart from cap & trade) still hinder fitness for purpose, to promote reduction of emissions and energy efficiency improvements. Further discussion of these shortcomings is outside the scope of this paper.

[6] The "worldtop" is either the worldwide top 10% (the efficiency of the 11th plant if 110 plants in the benchmark) or the average of the best geographical region (a region must contain at least 4 independent producers) or in case of limited benchmark data the Best Practice +10% (if Best Practice = 10 GJ/ton, the worldtop = 11 GJ/ton).

III.3.4 Assumption: caps necessary or better for investments to reduce emissions

This is another wrong assumption, which runs contrary to the aim of emissions trading. A lower emission achieved by a reduction project will inevitably become part of the historical reference needed to grant the cap in a future period.

Cap & trade & historical grandfathering
Uncertainty of reward of projects to reduce emissions
Lower emission will be in future reference period



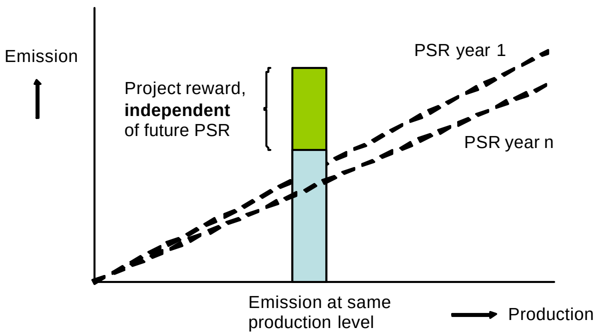
Timing of a reduction project becomes important to get the maximum return. A too early project (for example 2005) may lead to fewer allowances in the next trading period and anyhow in the subsequent period.
Investment projects with a lead time of 4 years from now need certainty for the allocation for the years 2009-2015 if emissions trading must have an impact as intended.

Striking examples are also other greenhouse gases like N_2O. Realised early reductions are in the current allocation practices not likely to get any reward. Too fast reductions from now on also have the highest chance of getting no reward.

The greediness of current tight allocation rules – limiting the amount of allowances to incumbents and especially to new entrants – achieve the opposite of what the Directive intends to achieve. Generally a wait and see attitude in industry can be observed.

In contrast, PSR passes the test of fitness for purpose:

PSR: long term market liquidity by certainty of reward of projects to reduce emissions



The amount of allowances is not dependant anymore on historical emissions.

Key feature of PSR

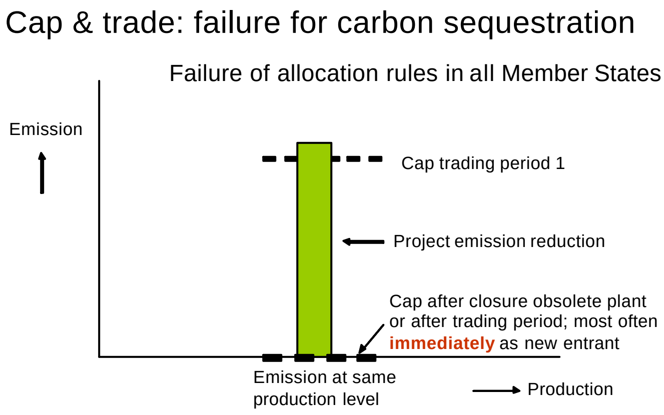
It is crucial to recognise that a project reward is also independent of the PSR itself[7]. This gives certainty of a predictable business environment which means that the promotion of reductions and energy efficient technologies is guaranteed, as requested by the Directive.

[7] Example: if a project reduces the emissions from 800 to 600 kg CO_2/unit of product the project reward is 200 kg CO_2/unit of product. This reward is independent of the future development of the PSR – say from 700 to 650 kg CO_2/unit of product, or later to any other number (PSR 700: reward is 100 avoided buying + 100 sales = 200; PSR 650: reward is 150 avoided buying + 50 sales = 200).

III.3.5 An ultimate test: zero emission projects

Cap & trade as it is currently applied will turn out to be the decisive obstacle for sequestration projects (carbon capture and storage), an ultimate test of the effectiveness of the cap & trade theory.

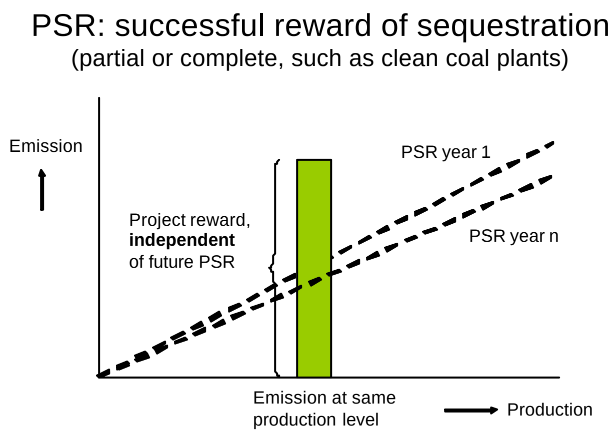
The common practice for new entrants is to grant few or no more allowances than needed. This would give clean coal plants few or no allowances from the start. When replacing older plants with emissions current cap & trade rules of virtually[8] all Member States fail as well. At least zero emission will become the historical reference for the allocation of allowances for a subsequent trading period. However, in most Member States allowances of existing installations are withdrawn after this installation is closed (and replaced by a zero emissions plant).



Cap & trade fails the test of the ultimate emission target (zero emissions). Sequestration projects cannot survive without a meaningful price of CO_2 – probably in the order of magnitude of € 20-25/ton after 5-10 years of development from now.

In contrast, PSR passes the test again:

PSR gives a predictable business environment. This is a prerequisite for the long-term certainty of the environmental outcome.



[8] Germany has a transfer arrangement, but this has also disadvantages (see further under III.7.3.). Under PSR the problem does not occur. Allowances are only obtained when producing.

III.4 Summary of fundamental problems with the current approach

The current approach “caps & trade” is characterised by a set of key features, which are so many causes of concern:

- Countries and companies falling under emissions trading are confronted with predetermined (ex-ante) fixed caps. There is a decoupling with the production factor.
- The focus of the European Union for long-term fixed caps for countries seems to emerge as an insurmountable obstacle to get USA and the industrialising nations aboard.
- The leading principle to impose caps on companies was historical grandfathering: allowances were granted on the basis of historical emissions. Historic reference periods and allocation formulas were different in different Member States leading to serious competitive distortions between same installations with a similar performance.
- In a true cap system new entrants and expansions of current plants should purchase all needed allowances. Although a legally non-binding guidance note of the European Commission argues that this is allowed, no Member State of the European Union has dared to apply this option as it runs so obviously against equal treatment. Therefore allowances are granted from a reserve. But if a finite reserve for new entrants is exhausted equal treatment – as required by the EC Treaty –is clearly violated.
- Current rules with ex-ante caps create the possibility for “windfall profits” for electricity producers at the expense of industrial users and the consumer. The aimed-at optimization profit for all participants turns into a one-sector winner.
- Member States struggled with imposing caps whilst obeying the requirements of the Directive. One major debate throughout Europe was "how representative is the chosen historical reference period”. There is great uncertainty within governments and the business community on the imposition of new caps for subsequent trading periods. This poses a problem with the aim to promote reductions.
- In addition to problems associated with ex-ante caps, numerous detailed allocation rules also run contrary to the aim of the Directive emissions trading. Improvements are not stimulated for example expansions, investments in a better design with lower emissions and energy efficiency are “rewarded” with fewer allowances in most Member States; the stimulation is zero or even negative because of a general compliance factor to keep the amount of allowances within the overall cap.

III.5 Ex-ante caps and historical grandfathering cannot be sustainable

Member States struggled with the determination of ex-ante caps in the current NAPs and there is no clue how the ex-ante caps are to be determined for next trading periods. It is remarkable that also in the scientific community advocates of cap & trade cannot define a sustainable methodology, which meets the requirements of the EC Treaty and the Directive.

III.6 Requirements of the Directive emissions trading and the EC Treaty

The main requirements are:

- Equal treatment between existing producers, existing producers and new entrants and between new entrants (EC Treaty and Directive, Annex III, section 5).
- The competition rules to secure a free market in which potential winners of market share are not hindered by the requirement to buy allowances in favour of losers of market share who can sell allowances (EC Treaty and Directive, Annex III, section 5).
- Environmental integrity meaning to avoid “leakage” of emissions (Directive, recital 3). Leakage is to produce outside the European Union and in fact to export emissions.
- Emissions trading must promote reductions and energy efficiency improvements (Directive, article 1 and recital 20).
- The application of the “polluter-pays” principle (EC Treaty).

III.7 Problems with historical grandfathering encountered in practice

III.7.1 Property rights

In the past, some companies claimed that emission allowances were some kind of property rights. Sometimes, the emission of 1990 was claimed as property. Practice shows that Member States chose the latest available emissions' data as close as possible to the trading period. The view about property rights is not heard anymore, because of the absence of any legal basis. If this claim would be accepted, it would be very difficult for legislators to adopt environmental policies. Moreover, there would be a conflict with equal treatment between existing producers and new entrants.

III.7.2 New entrants

Granting allowances to new entrants is felt as a major problem, not only by companies but increasingly also by government officials from Member States. Most practices do not stimulate efficiency and further reductions. More importantly, companies planning new investments are confronted with great uncertainties.

- Concerning Italy the leading government official stated to have great difficulty to grant allowances to planned new power plants. Which utilisation can be expected (what is "representative?"), to which extend will the new power plants produce electricity at the expense of older less efficient power plants, which already got allowances.
- Germany therefore decided to apply ex-post corrections if the realised production is lower than the forecasted production. Ex-post corrections were forbidden by the Commission, but Germany has challenged the decision in the Court of First Instance in Luxembourg. In any case, the German system is not fully competition proof because new plants can realise a high production by lowering production in older existing plants as mentioned above (provided they have grandfathered caps, as is mostly true).
- New entrants get allowances from a reserve. If the reserve is depleted they must buy all allowances (only Germany provides allowances via banks). This may be less of a problem in the short first trading period; however it will be a major problem for significant investments in the second trading period. Companies may be forced to renounce from the investment in the EU and to invest it outside the European Union.
- Even worse, Member States could change their position and let new entrants buy all allowances they need to surrender. The Commission allows this practice in the guidance note on allocation, claiming that this still is "equal treatment". This possibility adds to the uncertainty of companies.
- Another widely applied practice is to grant allowances according to Best Available Technique (BAT) and in various cases "never more than needed" (Netherlands). New, more efficient plants can rarely become a seller of allowances; thus more efficient designs are not stimulated and rewarded. And in the next trading period such plants may become victim of historical grandfathering. So again no reward and stimulation to do it the utmost in the design. These allocation rules are contrary to objective of the Directive (article 1 and recital 20), which requires stimulating energy efficient technologies.
- In conclusion, decoupling allowances from the production factor and applying different yardsticks to different plants within and between different Member States pose a variety of problems, which cannot be remedied under cap & trade.

III.7.3 Closures

Plant closures also lead to undesired effects in many Member States:

- In most Member States there will be no allowances anymore after closure.
- If a company shuts down an older less efficient plant and shifts the production to more efficient other existing plants, the company needs to purchase allowances. This does not reward for closing an obsolete plant and improving overall efficiency; it severely punishes the closure because of the fixed cap for the remaining plants.
- Correcting this disadvantage by letting shut down plants retain their allowances is also unjust:

  - o Possibly a producer shuts down a plant and accepts loss of market share, for example because the company has not much spare capacity.
  - o Or the company shifts production outside the EU.
  - o The historical reference period of remaining plants may antedate the closing down of the obsolete plant. Then the shortage of allowances will appear in the next (5-year) trading period. Note that the remaining plants can be in different Member States with different rules. In this context, it is repeated that the reference period for a next trading period is unknown and a problem anyway.
- Germany saw this problem and introduced a "transfer arrangement". The allowances of a closure can be transferred to a new plant. But what happens when the producer has sufficient existing spare capacity. Another problem arises if the replacing new investment takes place in another Member State. In addition, there is no equal treatment between this producer and another producer with a new plant who is seeking to win market share and who has no obsolete facility to close.
- Again the same conclusion: decoupling allowances from the production factor and applying different yardsticks to different plants within and between different Member States pose a variety of problems which cannot be repaired when sticking to cap & trade.

III.7.4 Competitive distortions: allocations differ from one Member State to another

The main tenet of allocation rules for incumbents was the average emissions of a historical reference period multiplied by a general reduction factor (C-factor) to keep allowances within the overall country cap. In reality allocation rules are more complex. They may involve provisions for growth different for each sector; there may be several C-factors (Germany). In the Netherlands there is a benchmark correction to require more efforts from inefficient producers and to reward efficient producers, with a very severe "worldtop" benchmark and a maximisation rule.

In the Netherlands, a high efficiency plant (better than worldtop) gets a reward while the same efficiency plant gets in other Member States historical emissions decreased with a C-factor. A plant performing the average European efficiency (much worse than worldtop) gets a severe penalty while in Member States with historical grandfathering and a C-factor the penalty is limited.

To give an example of the differences of the historical reference period: UK the highest 5 years of the 6 years 1998-2003. Germany generally applies 3 years 2000-2003; Netherlands 2001 and 2002. The C-factors differ in these countries. There is a benchmark correction in the Netherlands, which as a matter of principle is a step in the right direction.

This means that a plant with exactly the same production history and exactly the same efficiency receives a different allocation according to Member State. For example ammonia plants in the Netherlands with a much better performance than the severe "worldtop" (top 10%) benchmark and an unluckily low production in 2001 and 2002 – which happened – are buyers of allowances instead of sellers. The longer reference period in Germany and especially UK softens the unlucky low production in 2001 and 2002.

Decoupling allowances from production and applying different yardsticks to different plants within and between different Member States pose a variety of problems, which cannot be repaired when sticking to cap & trade.

The problem with the competition rules – also referring to Annex III (5) – is becoming clear now all NAPs for the 1st trading period are (virtually) finalised. Plants with similar performance and similar production history get different allocations in different Member States. These distortions have become more serious now the CO_2-price has risen to about € 20/ton, well beyond the expectation of € 5/ton communicated by the European Commission.

III.7.5 Polluter-earns principle

Historical grandfathering supports the polluter-earns principle. This is clearly shown in scientific literature[9]. Cap & trade based on historical grandfathering is in conflict with the polluter-pays principle (required by the EC Treaty, art. 174).

Some observations from for example J.R. Nash[10]:
"The [allocation] regime might create direct government subsidies if the government issues emission rights at no costs to polluters in relation to each polluter's historic emission. … The sulphur dioxide trading program [in the USA] suffers from this shortcoming by grandfathering most pollution allowances. … This sort of government subsidy runs contrary to the polluter-pays principle core, violating even the principle's weak form. …
Grandfathering of allowances creates a government subsidy in two ways. First, the government's distribution of free emissions allowances is tantamount to printing and distributing money to polluters. … The allowances are effectively coupons redeemable for cash. Second, distributing pollution allowances at no cost to polluters erects barriers that shield existing companies from competition from new companies entering the field".

Nash mentions also a solution: *"The government could distribute allowances free of charge to existing polluters, but not in accordance with prior pollution history. … For example, the government might distribute allowances in proportion to firm's energy efficiency".*

Granting caps with a benchmark factor minimises this problem, such as in the Netherlands. Although be welcomed as a first step in the good direction. However, the correction is technically not correct and there are maximisation constraints, which hamper the promotion of further investments to reduce emissions for efficient producers.

Most Member States had no benchmark factors to reward early action. Therefore in the majority of cases, historical grandfathering has led in most Member States to a grave conflict with the polluter-pays principle[11] (the footnote points at the incorrect transposition of the Directive and the importance of this principle).

In conclusion, most Member States have applied caps and in most cases the production factor has been denied. If the production gets lower than assumed from the reference period, there is again a problem with the polluter-pays principle. Only ex-post correction of the amount of allowances related to the deviation of the realised production from the forecasted production can solve this problem. This is the basis of the PSR approach.

III.7.6 Sustainability of ex-ante caps & historical grandfathering 2nd trading period

It is demonstrated that the transposition of the Directive in all Member States leading to ex-ante caps based on historical grandfathering leads to many undesired effects. Therefore it is hard to imagine why this methodology should continue to be entertained as a serious proposition in the 2nd trading period.

[9] See for example "A legal survey to emissions trading and competition concerns" by METRO, University of Maastricht (October 2002).
[10] Jonathan Remy Nash, lecturer in law University of Chicago Law School, Harvard Environmental Law Review, [vol. 24, 2000]
[11] The Commission states in the explanatory memorandum of the Directive proposal, that the allocation of allowances fulfils the polluter-pays principle as required by the Treaty. From this it can only be concluded that current allocation rules are not a correct transposition of the Directive. It is argued that the meaning of the polluter-pays principle is of utmost importance for the application of emissions trading. The scheme is the largest in its kind ever undertaken, when could it be more relevant?

III.8 Electricity and emissions trading

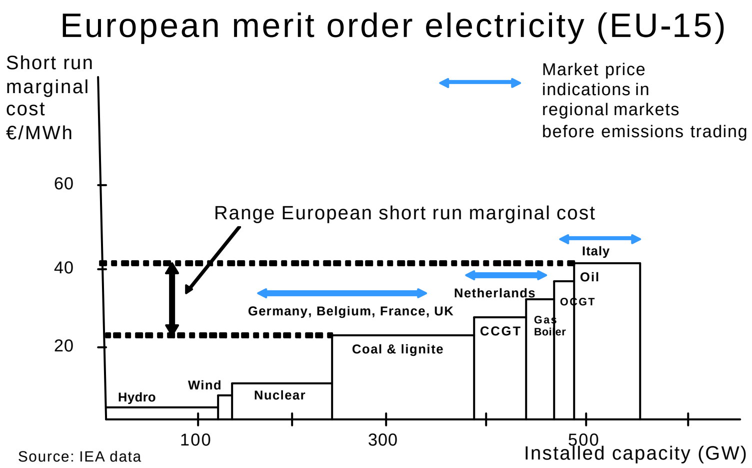
Electricity production plays a major role in the emissions trading scheme:

- In absence of global competition, electricity producers are able and forced by the cap & trade system to fully include the CO_2-price in the electricity price.
- This mechanism pushes up the price for electricity.
- Above a certain CO_2-price – probably in the range of € 15-20/ton – windfall profits will emerge and turn the scheme into a one-sector winner, the electricity sector.
- Windfall profits would further increase if a new entrant would need to buy all allowances.
- In conflict with competition rules, cap & trade hinders competition. Frozen market shares are enhanced; winners of market share must buy allowances while losers sell allowances. At a market price equal to fuel cost plus the incorporated CO_2-price, winning and losing market share is a zero sum game, a sharp contrast with liberalisation efforts underway to promote free competition.

III.8.1 Fuel switch

Fuel switch – the switch from coal-fired to gas-fired electricity – is a primary mechanism to reduce emissions in the short term. It needs a certain CO_2-price depending on the price differential between coal and gas. This mechanism is a major driver for the market price of CO_2.

In a market the price at which the last supplier and the last buyer agree is the price for the whole market. First the electricity market before emissions trading is illustrated below:



To achieve an emissions trading scheme that functions, the European Commission has created a shortage of allowances by scrutinizing National Allocation Plans (NAPs). NAPs with too high an allocation were forced to reduce the total amount of allowances below predicted emissions under a business as usual scenario. Currently, the total shortage in the EU-25 market is estimated at about 180-200 Mton CO_2 in the first 3-year trading period (about 60 Mton/year).

This shortage of allowances cannot easily be overcome by investments to reduce emissions; this requires a lead-time of several years. But electricity producers can switch from coal-fired electricity to gas-fired electricity in existing spare capacities ("fuel switch"). In this way electricity producers become net-sellers of allowances.

In a simplified model 2 fuel switch substitutions are illustrated (coal € 2.3/GJ and gas € 3.5/GJ):

Emissions data power plants

Full delivered fuel prices	€/GJ	
Coal	2,30	66%
Gas	3,50	

Merit order	1	2	3	4	5
	Cheapest				Most expensive

SRMC = Short Run Marginal Cost

					CO_2-price (EURO/ton)												
			ton CO_2	Fuel cost	5	**6,6**	10	12,5	15	17,5	20	**22,3**	25	27,5	30	32,5	35
Fuel	**Technology**	**Efficiency**	**per MWh**	€/MWh	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**	**SRMC**
Gas	**CCGT average**	**49%**	**0,41**	25,7	27,8	**28,5**	29,8	30,9	31,9	32,9	34,0	34,9	36,0	37,0	38,1	39,1	40,1
	Conventional	40%	**0,50**	31,5	34,0	34,9	36,5	37,8	39,1	40,3	41,6	**42,7**	44,1	45,4	46,6	47,9	49,2
Coal	Modern	40%	**0,85**	20,7	24,9	26,3	29,2	31,3	33,4	35,5	37,6	39,5	41,9	44,0	46,1	48,2	50,3
	Average	**37%**	**0,91**	22,4	27,0	**28,5**	31,5	33,8	36,1	38,4	40,7	**42,7**	45,2	47,5	49,8	52,1	54,4
	Old	35%	**0,97**	23,7	28,5	30,1	33,3	35,7	38,2	40,6	43,0	45,2	47,8	50,2	52,7	55,1	57,5

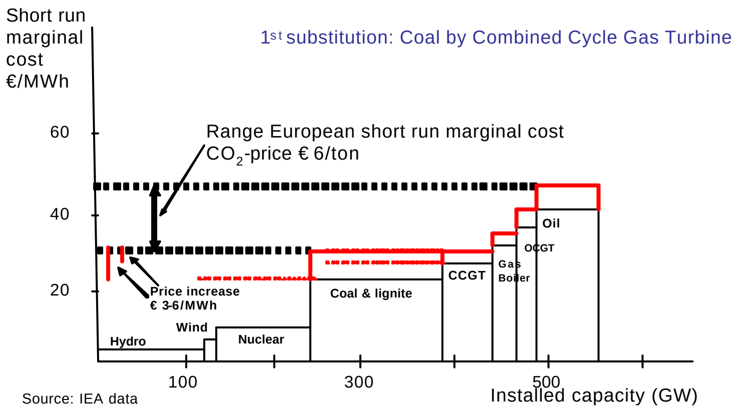
In this example the 1st substitution occurs at € 6.6/ton CO_2: electricity from coal is substituted by electricity from natural gas of Combined Cycle Gasturbine plants.

The 2nd substitution of coal by conventional gas boilers occurs at € 22.3/ton CO_2.

In both cases exactly the revenues of CO_2-allowances compensate the higher price for natural gas versus coal taking into account the different efficiencies in the use of gas and coal.

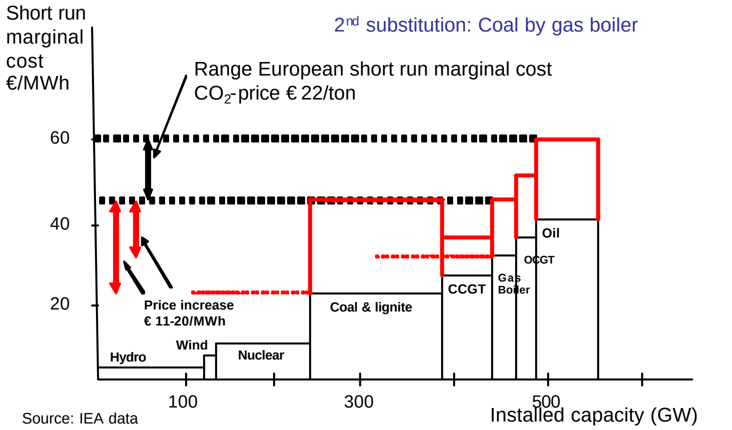
The 1st substitution is illustrated in the figure below:

1st substitution: influence on merit order



If there is still a shortage, the 2nd substitution will take place:

2nd substitution, same price difference coal - gas



III.8.2 Opportunity-cost principle

Under a cap & trade system, electricity producers have the opportunity to sell allowances if they lower production and not sell electricity. But unlike chemicals and many other commodities, electricity cannot be imported from outside the European Union. Therefore electricity producers can and do incorporate the full cost of CO_2-allowances in the price of electricity. This cost is known as the opportunity-cost because generally about 90%-95% of the needed allowances were granted free of charge to the electricity producers.

The opportunity-costs are illustrated below in a presentation of the (still) simplified model:

Substitution price (coal € 2.3/GJ; gas € 3.5/GJ)											**€/ton CO_2**	**6.6**	min	max			**€/ton CO_2**	**22.3**	min	max
Electrity opportunity cost												**€/MWh**	**2.7**	**6.1**				**€/MWh**	**11.2**	**20.4**
			Capacity	hrs/year:	Assume			Fuel	Substitution		Fuel	CO_2	Opp.	Opp.	Substitution		Fuel	CO_2	Opp.	Opp.
		ton CO2	Installed	8000	Load	Real	CO_2	Cost	**CCGT**	CO_2	Cost	Cost	Cost	Cost	**Boiler**	CO_2	Cost	Cost	Cost	Cost
		per MWh	GW	TWh	Factor	TWh	Mton	€ mln	TWh	Mton	€ mln	€ mln	€ mln	€ mln	TWh	Mton	€ mln	€ mln	€ mln	€ mln
Hydro		0	120	960	0.5	480	0		480	0	0	0	1,314	2,915	480	0	0	0	5,396	9,774
Wind		0	15	120	0.2	24	0		24	0	0	0	66	146	24	0	0	0	270	489
Nuclear		0	120	960	0.8	768	0	pm	768	0	pm	0	2,102	4,664	768	0	pm	0	8,634	15,639
Coal	37%	0.91	150	1200	0.7	**840**	768	18,798	**650**	594	14,546	-1154	1,779	3,947	460	420.7	10,294	-7738	5,171	9,367
CCGT average	49%	0.41	40	320	0.4	**128**	53	3,291	**318**	131	8,177	520	870	1,931	318	131.1	8,177	1744	3,575	6,476
Gas boiler	40%	0.50	30	240	0.2	**48**	24	1,512	48	24	1,512	0	131	291	238	120.2	7,497	2136	2,676	4,846
OCGT	35%	0.97	18	144	0.1	14.4	14	518	14.4	14	518	0	39	87	14	13.92	518	0	162	293
Oil	40%	0.75	60	480	0.62	297	223	9,359	297	223	9,359	0	813	1,804	297	222.8	9,359	0	3,340	6,050
				4424		**2600**	**1082**	**33,479**	**2600**	**987**	**34,113**	**-634**	**7,114**	**15,786**	**2600**	**909**	**35,846**	**-3859**	**29,223**	**52,935**
CO_2-reduction, sales to other sectors										**-95**						**-173**				
Real cost of fuel switch (additional fuel costs)													**634**	**634**		**-78**	additional		2,367	2,367
Opportunity-cost (€ mln)			(assumption: 100% grandfathering of allowances)										**6,480**	**15,152**					**26,856**	**50,568**
Revenues of CO_2-sales													**634**	**634**				**CCGT extra CO2-profit**	3,859	3,859
Total cash flow (€ mln)													**7,114**	**15,786**					**30,715**	**54,427**

The opportunity-costs are presented as a range, for the 1st substitution between € 2.7/MWh and € 6.1/MWh. This depends on whether CCGT or coal is the marginal plant in the market. In various regions coal is marginal during night and weekend and gas during working days. The real opportunity-costs are therefore best indicated by the average of the minimum and the maximum value, for example for the 1st substitution (6.5+15.1)/2 = € 10.8 billion/year.

The model above assumes a substitution potential of 95 Mton/year for CCGT and an additional potential of 78 Mton/year for conventional gas boilers, bringing the total potential to 173 Mton/year. However, other sources mention lower substitution potentials. This is indicated below; the total potential is now 120 Mton/year, which may be more realistic:

Substitution price (coal € 2.3/GJ; gas € 3.5/GJ)											**€/ton CO_2**	**6.6**	min	max			**€/ton CO_2**	**22.3**	min	max
Electrity opportunity cost												**€/MWh**	**2.7**	**6.1**				**€/MWh**	**11.2**	**20.4**
			Capacity	hrs/year:	Assume			Fuel	Substitution		Fuel	CO_2	Opp.	Opp.	Substitution		Fuel	CO_2	Opp.	Opp.
		ton CO2	Installed	8000	Load	Real	CO_2	Cost	**CCGT**	CO_2	Cost	Cost	Cost	Cost	**Boiler**	CO_2	Cost	Cost	Cost	Cost
		per MWh	GW	TWh	Factor	TWh	Mton	€ mln	TWh	Mton	€ mln	€ mln	€ mln	€ mln	TWh	Mton	€ mln	€ mln	€ mln	€ mln
Hydro		0	120	960	0.5	480	0		480	0	0	0	1,314	2,915	480	0	0	0	5,396	9,774
Wind		0	15	120	0.2	24	0		24	0	0	0	66	146	24	0	0	0	270	489
Nuclear		0	120	960	0.8	768	0	pm	768	0	pm	0	2,102	4,664	768	0	pm	0	8,634	15,639
Coal	37%	0.91	150	1200	0.7	**840**	768	18,798	**700**	640	15,665	-850	1,916	4,251	580	530.5	12,979	-5294	6,520	11,811
CCGT average	49%	0.41	40	320	0.4	**128**	53	3,291	**268**	110	6,891	383	733	1,627	268	110.5	6,891	1285	3,013	5,457
Gas boiler	40%	0.50	30	240	0.2	**48**	24	1,512	48	24	1,512	0	131	291	168	84.82	5,292	1349	1,889	3,421
OCGT	35%	0.97	18	144	0.1	14.4	14	518	14.4	14	518	0	39	87	14	13.92	518	0	162	293
Oil	40%	0.75	60	480	0.62	297	223	9,359	297	223	9,359	0	813	1,804	297	222.8	9,359	0	3,340	6,050
				4424		**2600**	**1082**	**33,479**	**2600**	**1012**	**33,946**	**-467**	**7,114**	**15,786**	**2600**	**963**	**35,041**	**-2661**	**29,223**	**52,935**
CO_2-reduction, sales to other sectors										**-70**						**-120**				
Real cost of fuel switch (additional fuel costs)													**467**	**467**		**-49**	additional		1,562	1,562
Opportunity-cost (€ mln)			(assumption: 100% grandfathering of allowances)										**6,647**	**15,319**					**27,662**	**51,374**
Revenues of CO_2-sales													**467**	**467**				**CCGT extra CO2-profit**	2,661	2,661
Total cash flow (€ mln)													**7,114**	**15,786**					**30,322**	**54,034**

In both models above the substitution went all the way to extinction (100% substitution of potentials). This analysis shows there is hardly any difference in opportunity-costs whether total or partial extinction is achieved. But in practice there is a difference because at a lower substitution higher efficiency CCGT will first replace lower efficiency coal plants, this happens at a lower equilibrium CO_2-price.

III.8.3 Impact of the price differential between coal and natural gas

The price differential between coal and gas has a great influence on the CO_2-price needed for fuel switch. This impact is illustrated with the same model (coal now € 2/GJ and gas € 4/GJ):

Full delivered fuel prices	€/GJ	
Coal	2.0	50%
Gas	4.0	

Merit order	1	2	3	4	5
	Cheapest				Most expensive

SRMC = Short Run Marginal Cost

Emissions data power plants

Fuel	Technology	Efficiency	ton CO_2 per MWh	Fuel cost €/MWh	5 SRMC	7.5 SRMC	10 SRMC	12.5 SRMC	15 SRMC	**19.8** SRMC	20 SRMC	22.5 SRMC	26.2 SRMC	27.5 SRMC	30 SRMC	32.5 SRMC	**40.4** SRMC
					CO_2-price (EURO/ton)												
Gas	**CCGT average**	**49%**	**0.41**	29.4	31.4	32.5	33.5	34.5	35.6	**37.5**	37.6	38.7	40.2	40.7	41.8	42.8	46.0
	Conventional	40%	**0.50**	36.0	38.5	39.8	41.0	42.3	43.6	46.0	46.1	47.4	49.3	49.9	51.1	52.4	**56.4**
Coal	Modern	40%	**0.85**	18.0	22.2	24.3	26.5	28.6	30.7	34.7	34.9	37.0	40.2	41.3	43.4	45.5	52.2
	Average	**37%**	**0.91**	19.5	24.0	26.3	28.6	30.9	33.2	**37.5**	37.8	40.0	43.5	44.6	46.9	49.2	**56.4**
	Old	35%	**0.97**	20.6	25.4	27.8	30.2	32.7	35.1	39.7	39.9	42.3	46.0	47.2	49.6	52.0	59.6

Fuel	Technology	Efficiency	Opportunity-cost in €/MWh (SRMC - fuel cost):												
Gas	**CCGT average**	**49%**	2.1	3.1	4.1	5.2	6.2	**8.1**	8.2	9.3	10.8	11.3	12.4	13.4	16.6
	Conventional	40%	2.5	3.8	5.0	6.3	7.6	10.0	10.1	11.4	13.3	13.9	15.1	16.4	**20.4**
Coal	Modern	40%	4.2	6.3	8.5	10.6	12.7	16.7	16.9	19.0	22.2	23.3	25.4	27.5	34.2
	Average	**37%**	4.6	6.9	9.1	11.4	13.7	**18.1**	18.3	20.6	24.0	25.2	27.4	29.7	**36.9**
	Old	35%	4.8	7.3	9.7	12.1	14.5	19.1	19.3	0.0	25.4	26.6	29.0	31.4	39.0

Currently (June 2005) the market price for CO_2 is € 19-20/ton. The higher price differential between coal and gas than assumed earlier is generally seen as the main reason. The prices for coal and gas in the model are an indication of current fuel prices.

Now € 19.8 ton CO_2 is needed for the same substitution which took place at € 6.6/ton at a smaller coal-gas differential. The 2nd substitution takes place at € 40.4/ton CO_2. The opportunity-cost[12] are included as well in the table above, this time expressed in €/MWh.

The significant increase of the CO_2-price from about € 7/ton in February 2005 to about € 20/ton in June 2005 has already led to a significant increase of the electricity price in Europe.

III.8.4 Fuel switch: probably not in 2005, but as from 2006

So far fuel switch did not occur in 2005. The reason is that 2005 might still be in the historic reference period for the 2nd trading period, as discussed earlier, which must be regarded as a perverse effect of cap & trade emissions trading. The price differential between coal and gas related to fuel switch in electricity has certainly already now an important influence on the price for CO_2, but the impact on the electricity price may behave phoney to some extend.

As fuel switch can be expected to start in 2006, the shortage of 3 years will have to be compensated in the remaining 2 years. Therefore and because fuel switch then really begins, it is expected that the impact on the electricity price will be more severe as from 2006.

[12] Opportunity-cost = SRMC (Short Run Marginal Cost) - Fuel Cost.

III.8.5 Are full opportunity-costs necessary?

Two observations about the occurrence of opportunity-costs:

- In fact the revenues of sales CO_2-allowances compensate exactly for the higher cost of natural gas versus coal[13]. This means that opportunity-costs are not necessary in itself.
- Secondly, lowering production means only sales of allowances to a very limited extend. Production cuts of more than about 5% lead to a CO_2-price of zero because of lack of demand for CO_2-allowances. About half the emissions of companies under the scheme come from electricity (so about 1000 Mton/year) while the shortage of allowances is “only” 50-60 Mton/year.

But economic theory – trying to understand human behaviour in market pricing – stipulates that marginal effects of the marginal power plant will cause the integral effect.

III.8.6 Competition rules & cap & trade emissions trading

Free competition in Europe is assured by the competition rules of the EC Treaty. It means that electricity producers engage to fight for market share. This happens when users of electricity get the possibility of choice of a supplier. However, disfunctioning of the markets In Europe is often mentioned. But what is the consequence recently introduced of the cap & trade regime?

It is often reported[14] that frozen caps will enhance frozen market shares. This mechanism is valid for any product and the effect will become more severe as CO_2-prices increase. When during the first trading period the CO_2-market has reached equilibrium, because of fuel switch by electricity producers, electricity from coal or gas is generally the marginal product. In various regions coal is marginal during night and weekend and gas during working days.

Winning market share can be achieved by buying allowances while losers of market share will sell allowances to achieve equilibrium again. But in this case the producers winning market share have to incorporate the CO_2-price in the price for electricity. This is the logic of free competition.

Therefore, in contrast with conventional wisdom, free competition is not the solution to the problem of opportunity-costs[15]. This will be elaborated further below.

The effects of free competition are illustrated by some model calculations. What happens when producers seek to win market share by better marketing? Let us first consider the situation without emissions trading for market share shifts between plants with the same efficiency (price of CO_2 = zero):

Market share shifts between producers with the same fuel and efficiency

Assume equilibrium for allowances	Producer	Efficiency CO2-price 0.0	Ton CO2 per MWh	Fuel cost €/MWh	Assume market price €/MWh	Market share Mwe	Income above fuel cost € mln/year	Market share change Mwe	Effect of market share shifts Allowances purchases kton CO2	€ mln/year	marginal Mwe €/MWh	Margin of winning or losing market share €/MWh	€ mln/year
Gas	A	49%	0.41	29.4	**37.5**	500	36	550	181	0.0	0.0	**8.1**	**4**
	B	49%	0.41	29.4	**37.5**	500	36	450	-181	0.0	0.0	**8.1**	**-4**
Coal	C	37%	0.91	19.5	**37.5**	500	79	550	401	0.0	0.0	**18.1**	**8**
	D	37%	0.91	19.5	**37.5**	500	79	450	-401	0.0	0.0	**18.1**	**-8**

The market share winner has a profit, as expected in a free market.

[13] In the examples of the tables above: € 634 mln/year and € 467 mln/year.
[14] Also by this author.
[15] Free competition as the solution is asserted for example by the Dutch ministry of economics (letter to parliament) and also several industry associations.

Now with emissions trading, assume the market price is exactly fuel costs + opportunity-costs:

Market share shifts between producers with the same fuel and efficiency													
Assume equilibrium for allowances	Producer	Efficiency CO2-price 19.8	Ton CO2 per MWh	Fuel cost €/MWh	Assume market price €/MWh	Market share Mwe	Income above fuel cost € mln/year	Market share change Mwe	Effect of market share shifts Allowances purchases kton CO2	€ mln/year	marginal Mwe €/MWh	Margin of winning or losing market share €/MWh	€ mln/year
Gas	A	49%	0.41	29.4	**37.5**	500	36	550	181	3.6	8.1	**0.0**	**0**
	B	49%	0.41	29.4	**37.5**	500	36	450	-181	-3.6	8.1	**0.0**	**0**
Coal	C	37%	0.91	19.5	**37.5**	500	79	550	401	7.9	18.1	**0.0**	**0**
	D	37%	0.91	19.5	**37.5**	500	79	450	-401	-7.9	18.1	**0.0**	**0**

The profit of the market share winners went to zero. From this it can be concluded:

- **The free market is hindered by the cap & trade system of allocation.**

What happens if the electricity price is for example € 4/MWh lower than opportunity-costs?

Market share shifts between producers with the same fuel and efficiency													
Assume equilibrium for allowances	Producer	Efficiency CO2-price 19.8	Ton CO2 per MWh	Fuel cost €/MWh	Assume market price €/MWh	Market share Mwe	Income above fuel cost € mln/year	Market share change Mwe	Effect of market share shifts Allowances purchases kton CO2	€ mln/year	marginal Mwe €/MWh	Margin of winning or losing market share €/MWh	€ mln/year
Gas	A	49%	0.41	29.4	**33.5**	500	18	550	181	3.6	8.1	**-4.0**	**-2**
	B	49%	0.41	29.4	**33.5**	500	18	450	-181	-3.6	8.1	**-4.0**	**2**
Coal	C	37%	0.91	19.5	**33.5**	500	62	550	401	7.9	18.1	**-4.0**	**-2**
	D	37%	0.91	19.5	**33.5**	500	62	450	-401	-7.9	18.1	**-4.0**	**2**

From this case a very important conclusion can be drawn: losing market share is more profitable than winning or maintaining market share. In other words, it is more profitable not to produce electricity and to sell allowances. This means:

- **Cap & trade the serves as a cushion to keep market prices at least on the level of fuel costs + opportunity-costs.**
- **When CO_2-prices rise, fuel + opportunity-cost achieve the electricity market price.**
- **At a further rise, the higher opportunity-cost push up the electricity market price.**
- **Only at a <u>higher</u> price than fuel + opportunity-cost, winning market share is interesting again.**

III.8.7 Opportunity-costs and windfall profits

Fixed costs including depreciation are indicated as follows[16]:

Costs above fuel	**New CCGT (Combined Cycle Gasturbine) 600 MWe**	**New coal plant 750 MWe**
	€/MWh	€/MWh
Variable Operating & Maintenance	1.50	3.33
Fixed Operating & Maintenance	2.33	3.50
Capital cost incl. ROI excl. depreciation	2.90	7.42
Fixed cost incl. ROI	**6.73**	**14.25**
Depreciation	2.85	5.23
Long-run marginal fixed costs	**9.58**	**19.48**

In a truly competitive market, prices are depressed in case of oversupply; prices on the level of long run marginal cost or higher can be obtained when the market is in tight supply.

[16] Source: "Emissions trading and its possible impacts on investment decisions in the power sector", by Julia Renaud, 2003, IEA (International Energy Agency)

It was concluded that opportunity-costs serve as a cushion to keep margins on at least the level of fuel costs + opportunity-costs. Therefore, above a certain level of gross margin, the higher opportunity-costs caused by cap & trade emissions trading must be regarded as windfall profits or economic rent. This level depends on the market situation (long or short supply).

From the table under III.8.2 we can observe that opportunity-costs have come around the level of the indicated long-run marginal fixed cost. The model shows following results:

Substitution price at fuel prices:					Coal:	**2.00**	Gas:	**4.00**				**€/ton CO_2**	**19.8**	min	max			**€/ton CO_2**	**40.4**	min	max
Electrity opportunity cost					(spot prices May 23, 2005)								**€/MWh**	**8.1**	**18.1**				**€/MWh**	**20.4**	**36.9**
		Fuel cost €/MWh	**ton CO2** **r MWh**	Installed GW	Hrs/year: 8000 TWh	Assume Load Factor	Real TWh	CO_2 Mton	Fuel Cost € mln	Substitution **CCGT** TWh	CO_2 Mton	Fuel Cost € mln	CO_2 Cost € mln	Opp. Cost € mln	Opp. Cost € mln	Substitution **Boiler** TWh	CO_2 Mton	Fuel Cost € mln	CO_2 Cost € mln	Opp. Cost € mln	Opp. Cost € mln
Hydro		0	0	120	960	0.5	480	0		480	0	0	0	3,910	8,675	480	0	0	0	9,785	17,724
Wind		0	0	15	120	0.2	24	0		24	0	0	0	195	434	24	0	0	0	489	886
Nuclear		pm	0	120	960	0.8	768	0		768	0	pm	0	6,255	13,880	768	0	pm	0	15,656	28,359
Coal	37%	19.5	0.91	150	1200	0.7	**840**	768	16,346	**650**	594	12,649	-3,434	5,294	11,748	460	420.7	8,951	-14,032	9,377	16,986
CCGT average	49%	29.4	0.41	40	320	0.4	**128**	53	3,762	**318**	131	9,345	1,548	2,590	5,747	318	131.1	9,345	3,162	6,482	11,742
Gas boiler	40%	36.0	0.50	30	240	0.2	**48**	24	1,728	48	24	1,728	0	391	868	238	120.2	8,568	3,873	4,852	8,788
OCGT	35%	41.1	0.97	18	144	0.1	14.4	14	592	14.4	14	592	0	117	260	14	13.92	592	0	294	532
Oil	40%	36	0.75	60	480	0.62	297	223	10,696	297	223	10,696	0	2,420	5,370	297	222.8	10,696	0	6,057	10,971
					4424		**2600**	**1082**	**33,124**	**2600**	**987**	**35,011**	**-1,886**	**21,173**	**46,981**	**2600**	**909**	**38,153**	**-6,997**	**52,992**	**95,989**
CO_2-reduction, sales to other sectors											**-95**						**-173**				
Real cost of fuel switch (additional fuel costs)														1,886	1,886		**-78**	additional		5,029	5,029
Opportunity-cost (€ mln)				(assumption: 100% grandfathering of allowances)										**19,286**	**45,095**					**47,963**	**90,960**
Additional above first substitution																			**Additional:**	**28,676**	**45,865**
Revenues of CO_2-sales														1,886	1,886					6,997	6,997
Total cash flow (€ mln)														**21,173**	**46,981**					**54,959**	**97,957**
Additional above first substitution																			**Additional:**	**33,787**	**50,975**

Conclusions

- At the current price of about € 20/ton CO_2 opportunity-cost of around € 30 billion/year serve to generate a guaranteed favourable profit.
- It can be argued that part of this profit can be regarded as windfall profit.
- The optimisation profit of the scheme at this CO_2-price is estimated by the European Commission to be about € 2.5 billion/year.
- Higher CO_2-prices will occur if the differential of the price for coal and gas increases.
- At higher CO_2-prices, profits of electricity producers will explode. As an example, at a price € 40/ton CO_2 profits will further increase with about € 40 billion/year.

III.8.8 Uncertainty for the development of CHP

Under the current allocation rules, CHP (Combined Heat & Power) is hardly stimulated apart from the higher price of electricity caused by the opportunity principle. As the latter is not perceived to be sustainable, new CHP investments will not be based upon this mechanism.

III.8.9 Long term effects

The purpose of emissions trading is to promote reductions and to promote reductions in the most economically efficient manner (Directive, article 1). But it is a riddle for electricity producers to answer the question what their long-term behaviour should be.

Using more gas and less coal turns out to be a decision of the legislator by determining the overall cap. Increasing efficiency and investing in lower carbon emitting technologies are risky undertakings as fewer allowances will result sometime in the future. Producers would rob their own purse. Investment decisions for electricity have become very complex in the cap & trade system; timing and political pressures on the producers appear to be determining factors.

Free competition is characterised by trying to gain market share through a lower cost price, a better efficiency and better marketing. It is concluded that cap & trade does not encourage but severely inhibits free competition.

III.9 Coverage: who falls under the Directive

The coverage of the Directive is interpreted differently in the Member States. Sectors not mentioned in Annex I of the Directive – such as the chemical and the food industry – are treated under different definitions. This causes competitive distortions. Two main definitions are applied. The European Commission and Member States have declared to aim for a harmonised coverage as from 2008, but great hesitation seems to prevail.

III.9.1 Broad definition

The Commission explained the so-called broad definition as the correct definition according to the Directive[17]. A site falls completely under the scheme if either (1) the sector is mentioned in Annex I (such as steel & paper, exceeding certain site capacity thresholds) or if (2) the site contains energy activities with a combined capacity of a rated thermal input capacity exceeding 20 MW, causing combustion emissions.

For example chemical sites fall under the Directive by the latter criterion, if steam boilers for the site exceed the rated input threshold of 20 MW (roughly 20 ton/hr steam production).

The real broad definition is applied in a rather limited number of Member States, notably Austria and the Netherlands.

This interpretation is in accordance with the definition of "installation" of article 3 of the Directive: *""Installation" means a stationary technical unit where one or more activities listed in Annex I are carried out and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution".*

Greenhouse gas emissions from activities not listed in Annex I do not fall under the Directive. This means that for example non-combustion emissions – such as process emissions from chemicals (for example from ammonia production) – are excluded from the scheme.

Many chemical processes use steam and electricity while the steam is taken from one or more site boilers. When the potential to reduce emissions[18] has to be taken into account for the allocation of allowances, chemical processes using too much steam – they have a potential to reduce emissions – have an effect on emissions of the "installation", the site. Therefore, the energy efficiency of such processes needs to be taken into account.

It is obvious to apply one uniform yardstick – one PSR for similar processes – to determine this potential to reduce emissions to avoid competitive distortions across the participants of the scheme[19]. This harmonised approach is logical because Annex III, criterion 5, requires: *"The [national allocation] plan shall not discriminate between companies or sectors in such a way as to unduly favour certain undertakings or activities in accordance with the requirements of the [EC] Treaty, in particular Articles 87 and 88 thereof".*

III.9.2 Middle definition

In the middle definition the combustion emissions from plants on a site not listed in Annex I are excluded. For example on a chemical site the boilers fall under the scheme but combustion

[17] Non-paper on the installation coverage of the EU emissions trading scheme and the interpretation of Annex I (September 2003).
[18] According to Annex III, criterion 3.
[19] In the eyes this author it is amazing that the EU Commission nevertheless authorized the application of historical grandfathering in its so-called guidance note on allocation. Further discussion of this guidance note falls outside the scope of this paper.

emissions from plants like ammonia or steamcrackers are excluded. Most Member States, including Germany and UK, have applied this definition.

It must be recognised that for example chemical sites as a whole are affected in the broad as well as in the middle definition. All chemical plants have a technical connection with the site utility system, for example boilers and/or CHP. Because of the technical connection the middle definition is formally incorrect (conflict with article 3, definition of installation).

Unintended, undesired and unfair effects are reasons to abandon the middle definition:

- A new entrant being a new chemical plant using steam causing higher emissions of the site boilers is not recognised as a new entrant and gets therefore no allowances from the reserve for new entrants, in case no new utility capacity is needed[20].
- One example was bizarre as no extra utility capacity was needed because of earlier energy saving projects of chemical plants.
- Even when PSRs are applied to determine a cap based on historical emissions – such as in the Netherlands – the PSR for the utility system (example: 90% efficiency for steam boilers) is insufficient to determine the potential to reduce emissions of that site ("installation").
    - A site with inefficient chemical or food processing plants would receive many allowances, supporting the polluter-earns principle.
    - A site with efficient plants would receive few allowances (no reward for early action[21]) and would be discriminated if compared to a site with inefficient plants.
- Every energy-saving project undertaken would automatically be punished by fewer allowances in the allocation of a subsequent trading period. This would be a grave conflict with the purpose of the Directive (article 1) and the statement of recital 20:
    - *"This Directive will encourage the use of more energy-efficient technologies, including combined heat and power technology, producing less emissions per unit of output, while the future directive on the promotion of cogeneration based on useful heat demand in the internal energy market will specifically promote combined heat and power technology".*
- These problems apply to both a cap & trade and a PSR approach.

III.9.3 Definition of coverage must be harmonised

In order to eliminate distortions, the definition must be harmonised. This can be done by clarifying the Directive or by agreements between the Member States[22].

The Dutch government has proposed to exclude sites with an emission lower than 25 kton CO_2/year[23]. This approach is recommended to minimise administrative burdens and to enable the easier introduction of the correct broad definition.

The Netherlands also applied an opt-out option for the 1st trading period for complete sites which fall in the Netherlands under the scheme but which are outside the scheme elsewhere. The reason – accepted by the EU Commission – was to eliminate competitive distortions.

Distortions must be remedied by a harmonised definition. The remedy must not distort again. Harmonising on the middle definition for the 2nd trading period would create new competitive distortions, in conflict with Annex III (5) and the purpose of the Directive as demonstrated above.

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[20] Examples were reported from Germany and the UK.
[21] The Directive states: "The plan may accommodate early action" (Annex III, criterion 7). It is argued that the freedom not to accommodate early action is in conflict with the effectiveness of the scheme and with the prohibition to discriminate between sectors or companies (Annex III, criterion 5, quoted above).
[22] A group of Member States is suggested to take the lead without waiting for completeness.
[23] This was approved by the Commission for the 1st trading period as an opt-out (the "small opt-out").

III.10 Burden Sharing Agreement & the allocation of allowances

Burden Sharing Agreement
The EU target of 8% reduction of greenhouse gas emissions compared to the emissions of 1990 was split up in 1997 between Member States with differentiated targets in the Burden Sharing Agreement.

Luxembourg (-28%), Germany (-21%) and UK (-12.5%) have stringent targets and are well underway to achieve these targets. In Luxembourg a steel plant was closed. Germany undertook great efforts to restructure the economy of the former DDR. UK closed many obsolete coal-fired power plants and replaced them with modern gas-fired plants.
Portugal (+27%), Greece (+25%), Spain (+15%) and Ireland (+13%) got the possibility to increase their welfare towards the general level of the European Union.

Since 1997 welfare development in for example Spain – fortunately – developed beyond expectations. This development is in line with the Lisbon strategy aiming at more welfare, employment and social stability. Is it then fair to say that Luxembourg does a good job in contrast with Spain? This assertion is often suggested in Commission communications.

The new Member States – having many older production plants with a rather low efficiency – appear to have less difficulty with their target under the Burden Sharing agreement. Is it then fair to say they are doing a good job? Don't we want also there a prosperous development leading to a competitive industry, more welfare, more jobs and social stability under the Lisbon strategy?

Influence Burden Sharing Agreement on allocation of allowances
In contrast with some perceptions, there is no uniform relationship between the allocation of allowances and the Burden Sharing Agreement. For example the UK has applied a rather tight allocation while Spain has granted allowances to industry more generously.

Nevertheless, one important criterion for the EU Commission to judge a national allocation plan is whether the total amount of allowances is below projected emissions. By its nature this will contribute to competitive distortions, for example as Member States with an efficient industry must restrict allowances within projected emissions.

III.11 Lottery / unpredictability of rules / no fitness for purpose

All kinds of competitive distortions including the claim that the reference period was not representative were reason for companies to file complaints and law suits. A European citizen as a distant observer concludes that the allocation of allowances between Member States looks like a lottery (reference period, different C-factor, etc.), and therefore rules are likely to change.

It can safely be concluded that companies face an unpredictable business environment. But the same companies should be stimulated to undertake investments to reduce emissions. One very reason for the emissions trading Directive was to preserve the integrity of the internal market, to reduce emissions and to support industry to achieve lowest cost solutions. At the current state of affairs companies do not undertake such investments and experience competitive distortions.

Discussions about the allocation focus on "how can we grant or get (almost) the needed allowances". The effectiveness of the scheme seems to have disappeared over the horizon. Unpredictable and ineffective practices have become central problems of current allocation rules. The rules are perceived as a lottery, not fit for purpose.

III.12 Cap & trade unity of fitness for purpose, polluter-pays, level playing field

These three key principles are closely interlinked. When the polluter-pays principle – required by the EC Treaty and claimed to be obeyed by the Directive[24] – is not obeyed, problems occur with fitness for purpose and the level playing field.

Historical grandfathering without a benchmark correction suffers from:

- No fitness for purpose;
- No compliance with the polluter-pays principle;
- No level playing field.

Under the current cap & trade, there is a unity indeed, it is a negative unity: all three principles are not obeyed.

Cap & trade with a benchmark correction is an important step in the good direction but many problems still persist as the production factor is forgotten. Benchmarking rewards early action and is claimed just to address fairness. It does not take account of sunk cost – as historical grandfathering does – due to investment decisions prior to the carbon constraint.

Accommodating sunk cost is in contrast with the polluter-pays principle. It also hinders to establish an effective trading scheme. Sunk cost can therefore only be accommodated temporarily, and this is now the case for the three years of the 1st trading period.

The logic of the Directive and the unity of fitness for purpose, polluter-pays and a level playing field lead to the following basic principles of allocation:

- ✓ Targets must focus on installations with possible efficiency gains and reward those that have already made significant reductions; this creates a logical demand and supply with an effective drive to reduce emissions.
- ✓ Effectiveness requires two drivers to be in place:
  - (1) A meaningful CO_2-price and, often neglected
  - (2) A clear incentive, a driving force in the amount of allowances to undertake investments to reduce emissions (polluter-pays principle)

Efficient existing plants and new entrants get most often no incentive for investments to reduce emissions. For example, current allocation rules make no difference for investments in CHP, which should be the case in an effective scheme.

The same is true for existing inefficient plants because their allocation is close to what they need. Why would they undertake investments with such a small incentive? This is even true at the current CO_2-price of about € 20/ton.

The effectiveness is clearly undermined when companies are hindered to shut down obsolete installations and shift production to efficient existing or new plants.

Under the current rules with historical grandfathering the opposite is achieved: the economic life of less efficient plants is extended instead of shortened. This is the logic when sunk costs are accommodated indefinitely.

[24] This is claimed in the explanatory memorandum of the draft Directive (2001).

III.13 Emerging recognition of the purpose problem

It has become clear that there is a fundamental problem with the determination of a justified cap for an individual producer. With cap & trade based on historical grandfathering, investments to lower emissions are punished because the lower emissions become part of a historical reference for a future trading period. As mentioned, likely changes of allocation rules will create a major problem of predictability of environmental policy. The recognition of this problem is also emerging within the European Commission. DG Environment – Peter Vis, Point Carbon conference, Amsterdam, 1-2 March 2005 – stated:

- *"The historical reference for the 2nd trading period should not include 2005. This would be perverse and against the purpose of the Directive".* And later he continued:
- *"The old reference should be taken, but this cannot go on forever … the next step for the 3rd trading period as from 2013 must be bold …… [not mentioning how]"*

Adherence to the current approach is no structural cure to the problem of historical emissions. As mentioned, the representativeness of a historical reference period was one of the most debated questions in the entire European Union. What is meant: how representative was the historical production if compared to the production in the future?

Periods before 2005 can therefore not be used forever, as also Peter Vis recognises. Why waiting for a change if the recognition of the fundamental problem is emerging? Mrs Wallström – the former Commissioner of DG Environment – often declared that the 1st trading period must be regarded as a learning-by-doing period.

Cap & trade gives great uncertainty for investors aiming to reduce emissions. In this respect, cap & trade is shown not to be superior to PSR, on the contrary, cap & trade is not only inferior but it is ineffective.

III.13.1 Length of a trading period

Because the ineffectiveness is becoming clear, the debate has started about the length of a trading period (for example panel discussion Marcus Evans conference in London 14-15 February 2005). Without updating caps for installations the effectiveness of cap & trade is the same as under PSR or auctioning. Quote from an advocate of cap & trade (March 2005):

"No sensible company will undertake serious investments to reduce emissions based on current allocation rules. What we need is a much longer period – for example 20-25 years – to achieve the incentive as intended by the Directive to undertake such investments".

But what would the target be? And how long should the period be? How would the amount of allowances be determined for a subsequent trading period after such a much longer trading period? Certain companies will undertake more reductions than others. And how do new entrants receive their allowances? If a reserve for new entrants is too small equal treatment is violated and economic growth is inhibited as investments are pushed out of the EU.

The guidance note of the Commission (January 2004) mentions three arguments why letting new entrants buy all allowances would be equal treatment: (1) they have a market to buy allowances – but this ignores substantial cost in contrast with incumbents; (2) they can minimise emissions in contrast with incumbents – but this ignores substantial cost in contrast with incumbents and for example zero incentive for clean coal at the start and in the future; (3) new installations need to buy allowances in only one trading period *("probably less than two years in the first period")*. The third argument excludes longer trading periods.

In fact the third argument disqualifies itself and the first two arguments: violation of equal treatment is admitted. One wonders why the first two arguments are even mentioned. All three arguments are incorrect; this is argued not to be a matter of debate but a scientific fact.

And how to cope with changes of market share? Innovative producers would be hindered to grow at the expense of inefficient slow movers with a harvest strategy. The “clean, clever and competitive” approach adopted by the European Council calls to reward frontrunners, innovation must be stimulated. This was already in the Directive (article 1 and recital 20) but the transposition into allocation rules has failed so far.

Longer trading periods are therefore no cure for the fundamental weaknesses of the cap & trade theory. Not the symptoms but the root causes need to be addressed. The production factor is forgotten, the major failure of any cap & trade system.

III.14 The current debate on harmonisation

The current debate on harmonisation of the allocation rules for the 2nd trading period focuses on rather simple options within the cap & trade system. Harmonisation is recognised as an absolute priority[25] because of the effectiveness of the scheme and because equal treatment should be obeyed. Different rules in different Member States lead to unacceptable competitive distortions.

But it is remarkable that options for harmonisation are far from conclusive, even in debates between experts (from government, industry and NGOs). Harmonisation subjects in debate are:

- Coverage: broad or middle definition
- Coverage: exclusion or opt-out for small installations (< 25 kton CO_2/year)
- New entrants, closures and transfer rules
- The use of benchmarking or auctioning
- Unilateral opt-in, for example aviation or N_2O

Harmonisation on the “simple” middle definition is a remedy that distorts again (see III.9).

It is said that theoretically new entrants must buy allowances. At the same time it is recognised that the implementation of more efficient new technologies is hindered instead of stimulated. No allowances for new plants and retaining allowances for closed plants are a consequence of the cap & trade theory. Firstly, this works only to some extend if there is a closure at the start of a trading period. Secondly, this creates barriers for new entrants that have not an obsolete plant to close, in violation of equal treatment.

A limited new entrants reserve is also not fit for purpose as it hinders the implementation of new innovative plants, it hinders economic growth without environmental justification and violates equal treatment.

Cap & trade is a very strange theory indeed. Removal of allowances after closure and the ex-post rules in Germany are contrary to this theory; a prisoner of the cap & trade theory can not find justified and legally-proof solutions for harmonisation. It is like the search for a square circle.

A PSR scheme does not show these inherent weaknesses. The length of a trading period becomes immaterial. Rules for new entrants and closures work well for effective progress. Innovation is clearly stimulated. And the principle of equal treatment is obeyed. In the PSR system allowances are linked to realised production like taxes in the fiscal year.

[25] See for example the 2005 CEPS (Centre for European Policy Studies) report “Business consequences of the EU ETS”.

III.15 Conclusion: non-compliance with the Directive & the EC Treaty

From the analysis above, it can be concluded that current allocation rules are in grave conflict with virtually all essential requirements that must be adopted for an effective trading scheme. All essential requirements are mentioned indeed in the Directive for emissions trading.

Requirements	Were we are today: cap & trade
Equal treatment between existing producers, existing producers and new entrants and between new entrants (EC Treaty and Directive, Annex III, section 5). Annex III, section 5: competitive distortions between producers and sectors are prohibited.	• Existing producers are confronted with different allocation rules in different countries, leading to serious competitive distortions; • The same is true for new entrants when there is still a reserve available; • When a reserve is depleted, new entrants face high cost in contrast with earlier new entrants and incumbents; this creates great uncertainty and will lead to negative decisions for energy intensive investments; • Windfall profits of the electricity sector turn the scheme into a one-sector winner.
The assurance of a free market in which potential winners of market share are not hindered by the requirement to buy allowances in favour of losers of market share who can sell allowances (EC Treaty and Directive, Annex III, section 5).	• Cap & trade enhances frozen market shares; • The opportunity-costs serve in the electricity market as a cushion for a minimum electricity price leading easily to windfall profits.
Environmental integrity leading to the need to avoid "leakage" of emissions (Directive, recital 3). Leakage is to produce outside the European Union and in fact to export emissions.	• Producers are forced to lower production when the price for CO_2 is high enough; • This happens also if in a longer (5-year) trading period new entrant reserves get depleted and investment decisions are aborted.
Emissions trading needs to promote reductions and energy efficiency improvements (Directive, article 1 and recital 20).	• Cap & trade hardly stimulates investments to reduce emissions; • Cap & trade is a killer for zero emission projects;
The application of the "polluter-pays" principle (EC Treaty).	• Historical grandfathering is in grave conflict with this principle.

From the presented analysis we can also conclude:

- That PSR complies with the requirements mentioned above;
- That certainty of the environmental outcome and market liquidity are inherently better for PSR than for cap & trade; transaction cost are not a determining factor;
- That also the European Commission conceded that historical grandfathering *"cannot go on forever … the next step must be bold".*

Getting the allocation for the 2nd trading period within the requirements of an effective emissions trading may be perceived as a bold step. From the viewpoint of PSR changing the Directive is not necessary. PSR is an objective criterion and allowances are granted on the condition that the forecasted production – not objective – is met. In case the realised production deviates from forecast, an ex-post correction is needed to remedy violations of the Directive.

The very least what must happen: each and every allocation rule of all Member States for the 2nd trading period must be tested by the European Commission against fitness for purpose.

The Commission has the ability and the power to clarify the allocation rules of Annex III to make "learning-by-doing" a true exercise. Otherwise eight more years from now on will be lost at the expense of effectiveness of the scheme and at the expense of credibility in the global arena.

IV Alternative: Performance Standard Rate

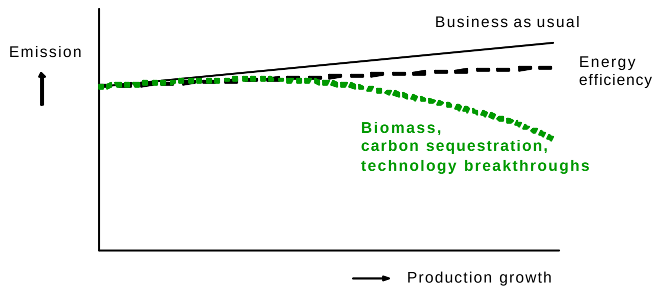
From here on the alternative is further addressed. How does PSR work and how can it be started. But first the policy objective is considered.

IV.1 Policy objective

The immense challenge to lower emissions while increasing global welfare at the same time is illustrated as follows:

PSR will ensure that all actors will pursue efficiency without regret. On top of this, additional support is needed for the development and implementation of breakthrough technologies including carbon sequestration.

Policy objective: decoupling emission & growth



IV.2 Cornerstones of PSR

The corner stones for a successful start and implementation are self-evident and less difficult as might be believed at first glance:

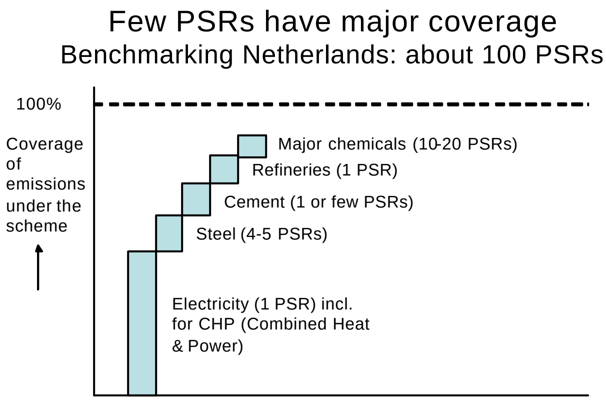
- **Start with major emitters:** limited number of products
- **PSR not timely available:** each operator starts with its own efficiency as a transition measure; establish PSR after first year
- **PSR must be below weighted average:** otherwise the market is unable to supply the shortage of allowances
- **PSR will gradually tighten:** to meet environmental goals
- **Amount of allowances:** PSR coupled to realised production of goods for society
- **Banking & lending:** this is needed for market stability; probably 5%-7% of volume will suffice
- **Recommendation for an independent "Climate Board":** similar as for monetary policy, making annual reviews, giving policy advice and adjusting when needed the PSR (or the Compliance Factor, see further below) or the banking & lending volume

If the PSR for certain major products is not timely available, retribution should not be extracted later. This would give uncertainty later in the market. The overruling principle must be that producers know right from the start that efficiency improvements will never be punished.

IV.3 BAT or top 10%

It is often considered that benchmarks should be tight, for example BAT (Best Available Technique) or top 10% ("worldtop" in the Netherlands and Flanders). However, the lead-time to reduce emissions would be taken into account insufficiently. This would cause a too great shortage of allowances in the market and hence lead to extremely high CO_2-prices. The scheme would not function; there would be no relation to abatement cost.

The limited number of products with a high coverage of emissions is illustrated below:



IV.4 Benchmark formula for PSR

Following benchmark formula will serve the purpose of avoiding competitive distortions, of achieving an effective trading scheme with unambiguous signals and to make use of BAT while at the same time account is taken of the potential of processes in their path towards BAT.

- **Benchmark data: population under the scheme**
  - Currently EU-25, in future with Norway, Canada, Japan, South Korea, etc.

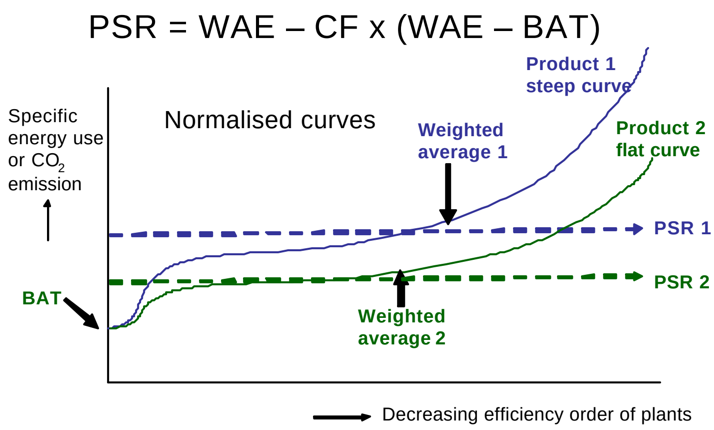
- **PSR = WAE – CF x (WAE – BAT)**
  - WAE = Weighted Average Efficiency
  - BAT = Best Available Technique (the proven Best Practice)
  - CF = Compliance Factor, equal for all PSRs, reflecting equal efforts between different types of installations

- **Compliance Factor**
  - 2008: CF = 3% to create a CO_2 market price
  - 2012: possibly 15%-20%

The formula takes account of different shapes of the efficiency curve for different products (the potential of processes in their path to BAT)[26]:

Products with a steep curve have a higher potential to reduce emissions, products with a more flat curve have a lower potential.

By gradually increasing the CF the demand on all products is increased. Nevertheless it should be noted that achieving BAT for an entire population takes a long lead-time.



[26] Therefore PSR = BAT + x% or PSR = average efficiency – y% are both unjust.

IV.5 PSR for smaller processes

There are many small processes, which also fall under the scheme of emissions trading. In view of the problems associated with cap & trade, allowances for such processes must also be based upon efficiency.

One option is to give a general penalty (C-factor). The benchmark experience in the Netherlands and Flanders shows that an energy audit may serve as an alternative for producers to avoid this C-factor. All energy projects identified with a certain IRR (in the Netherlands and Flanders: >/= 15% after taxes) can be regarded as distance to the PSR. This approach can be gradually introduced.

IV.6 PSR provides clear signals

The proposed approach provides unambiguous signals to all producers:

- Efficiency improvement will always be rewarded;
- It is also rewarding to improve BAT, which is an important climate objective.

IV.7 Calculation of energy efficiency

The energy efficiency of any process shall be determined by using uniform conversion factors for the use of heat and electricity. Further primary energy carriers need to be calculated according to one uniform heating value.

This is the approach taken by consultants active in energy efficiency benchmarking; otherwise comparisons between processes are not on equal footing.

Following conversions are recommended:

- Electricity: 40% efficiency on enthalpy, therefore 3.6/40% = 9.0 GJ/MWh
- Heat: 90% efficiency on enthalpy
- Heating value primary energy: Lower Heating Value (LHV)

Other conversions can be applied; they have only a secondary effect on the final result. It remains important to use uniform values, at least for similar processes.

IV.8 The conversion from energy efficiency to CO_2 allowances

The emissions trading in the European Union is a direct emission scheme. After each year allowances have to be surrendered equal to the realised direct emissions, meaning the emissions on site.

The conversion from energy efficiency to allowances can be easily achieved:

- **ALLOWANCES = REALISED DIRECT EMISSIONS – (REE – PSR) x CCF**
    - REE = Realised Energy Efficiency
    - CCF = CO_2 Conversion Factor of the marginal fuel

The marginal fuel is for many industrial processes and sites natural gas; then the CCF = 56 kton CO_2/PJ (or 56 ton CO_2/TJ or 56 kg CO_2/GJ).

For electricity no CCF is required. The amount of allowances is determined by the realised production of electricity and the realised amount of useful heat in case of CHP. This is further elaborated below.

IV.9 PSR and electricity

Unrestricted growth of coal-fired electricity is not feasible if carbon emissions need to be curbed. On the other hand, the use of coal and lignite cannot be avoided in the foreseeable future. Current allocation rules with caps lead to a modest fuel switch from coal to gas. From all NAPs it can be observed that CHP (Combined Heat & Power) is hardly stimulated. Especially coal and lignite are left with great uncertainties.

The alternative must therefore pursue following objectives:

- Improvement of the energy efficiency. The average efficiency of a coal plant in the EU-25 is about 38%, this can be improved to well over 40% (up to 43%-44%);
- The use of co-fired biomass must be stimulated;
- Clean coal must be unambiguously stimulated as soon as possible;
- Where heat is needed, CHP must become clearly stimulated.

Granting allowances according to the average emission of fossil-fuelled electricity in Europe, currently estimated around 750-800 kg CO_2/MWh produced, is therefore the only practical solution. This will eliminate windfall profits and also clearly stimulate CHP leading to lower emissions from electricity and heat. And improving energy efficiency will be stimulated as well (high efficiency coal-fired plants can achieve a performance below 800 kg CO_2/MWh).

The effect of a single PSR for electricity – preferably after some time for all renewables – is illustrated below:

Emissions data power plants

Full delivered fuel prices	€/GJ	
Coal	2.0	50%
Gas	4.0	

Merit order: 1 (Cheapest), 2, 3, 4, 5 (Most expensive)
SRMC = Short Run Marginal Cost

Fuel	Technology	Efficiency	CO2-efficiency/MWh Benchmark	Real	Fuel cost €/MWh	CO_2-price (EURO/ton) 5 SRMC	7.5 SRMC	10 SRMC	12.5 SRMC	15 SRMC	**19.8** SRMC	20 SRMC	22.5 SRMC	26.2 SRMC	27.5 SRMC	30 SRMC	32.5 SRMC	**40.4** SRMC
Gas	**CCGT average**	**49%**	**0.80**	**0.41**	29.4	27.4	26.5	25.5	24.5	23.6	**21.7**	21.6	20.7	19.2	18.7	17.8	16.8	13.7
	Conventional	40%	**0.80**	**0.50**	36.0	34.5	33.8	33.0	32.3	31.6	30.2	30.1	29.4	28.3	27.9	27.1	26.4	**24.1**
Coal	Modern	40%	**0.80**	**0.85**	18.0	18.2	18.3	18.5	18.6	18.7	18.9	18.9	19.0	19.2	19.3	19.4	19.5	19.9
	Average	**37%**	**0.80**	**0.91**	19.5	20.0	20.3	20.6	20.9	21.2	**21.7**	21.8	22.0	22.5	22.6	22.9	23.2	**24.1**
	Old	35%	**0.80**	**0.97**	20.6	21.4	21.8	22.2	22.7	23.1	23.9	23.9	24.3	25.0	25.2	25.6	26.0	27.3

Fuel	Technology	Efficiency	Opportunity-cost in €/MWh (SRMC - fuel cost):												
Gas	**CCGT average**	**49%**	-1.9	-2.9	-3.9	-4.8	-5.8	**-7.7**	-7.8	-8.7	-10.2	-10.7	-11.6	-12.6	-15.7
	Conventional	40%	-1.5	-2.2	-3.0	-3.7	-4.4	-5.8	-5.9	-6.6	-7.7	-8.1	-8.9	-9.6	**-11.9**
Coal	Modern	40%	0.2	0.3	0.5	0.6	0.7	0.9	0.9	1.0	1.2	1.3	1.4	1.5	1.9
	Average	**37%**	0.6	0.9	1.1	1.4	1.7	**2.3**	2.3	2.6	3.0	3.2	3.4	3.7	**4.6**
	Old	35%	0.8	1.3	1.7	2.1	2.5	3.3	3.3	0.0	4.4	4.6	5.0	5.4	6.7

Key features of a uniform PSR

- Fuel switch takes place at exactly the same CO_2-price as under cap & trade. This is also a reason that the step towards PSR is less risky than often assumed.
- The additional advantage is that the risk of windfall profits is eliminated; the opportunity-costs are small (coal) or negative (for gas including CHP).

In this approach plants more efficient than the PSR lower their cost price by selling CO_2-allowances, which is a normal feature in a sensible trading scheme.

Please note that better efficiency coal plants (especially with efficiencies up to 43%-44%) maintain a good market position in the medium term also at higher CO_2-prices.

IV.10 Biomass

Allocation rules should reward right from the start the use of co-firing biomass in power plants using coal or lignite. In this way coal and lignite used in existing power plants have an additional possibility to remain cornerstone of the fuel mix.

IV.11 The future of coal and lignite

Further reductions can only be pursued in case similar efforts are undertaken in the entire industrialized world. As demonstrated, PSR works as a suitable enabler for the technological breakthrough of clean coal.

Most coal and lignite plants will be buyers of allowances. But their direction is fully clear. There will be rewards for improving efficiency and for using biomass. Older plants get an incentive to be replaced earlier, shortly after 2012 with clean coal technology.

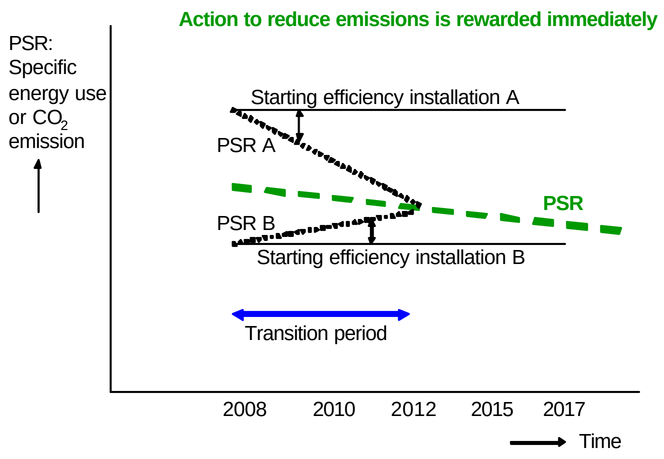
In other words, coal has a future in a carbon-constrained world, provided clear and predictable signals are given for the long term. These are necessary for any successful post-2012 policies. The required changes will take much lead-time and therefore a predictable business environment is required as soon as possible.

IV.12 A transition regime for sunk cost

It was concluded that sunk cost need to be regarded as a temporary situation. Emission reductions are especially required from less efficient installations which have the highest potential. Therefore from the viewpoint of sunk cost a transition regime could be considered.

A transition regime to accommodate sunk cost is illustrated in the following figure:

Transition regime to accommodate sunk cost



All plants or plants from a certain vintage, for example build before 1975 (around first oil crisis) get their own efficiency as starting PSR.

The less efficient installation A is immediately stimulated for action. Without action to reduce emissions the purchases of allowances increase gradually from zero to the distance from the PSR at the end of the transition period.

The efficient installation B has no allowances for sale in the first trading year. The efficiency reward gradually increases. Investments to reduce emissions are also stimulated from the beginning.

The carbon constraint has started as from 2005. The transition period and the plants falling under the transition regime are political choices. A transition period until 2010 or 2012 seems reasonable in view of the lead-time to undertake investments to reduce emissions.

IV.13 Burden Sharing with Solidarity Support

First the consequences of the current Burden Sharing Agreement are discussed. Next directions for solutions are indicated.

Consequences of the Burden Sharing Agreement
The Burden Sharing Agreement and the alternative of PSR have two consequences:

- Frictions for Member States with high efficiency industries
- Frictions for companies in Member States with low efficiency industries

The introduction of EU-wide PSRs has the effect that Member States with efficient industries have to grant more allowances if compared to the Burden Sharing agreement and projected emissions[27]. In other Member States the opposite may occur. This leads to (limited) economic frictions for former Member States, partly offset by higher corporate taxes.

In Member States with a relative less efficient industry – for example older installations of industries in less developed regions, such as in the new Member States – these frictions apply not for those Member States. But it will lead to frictions for companies when they need to restructure obsolete production facilities.

Alternative to transition regime: solidarity support to enhance the Lisbon strategy
A reallocation of part of the resources from EU funds to these real, pressing and solvable problems can help to mitigate the mentioned frictions. Such an approach is a better alternative to a transition regime in order to keep the system clear right from the beginning.

Contributions from such funds will reduce the transition costs in the run-up to an effective trading scheme. Support for innovation will strengthen the transition to a less carbon intensive society and will contribute to the aims of the Lisbon strategy.

IV.14 PSR: real unity of fitness for purpose, polluter-pays, level playing field

Under the PSR approach, the unity of the three basic principles is achieved as demonstrated in this study. Numerous examples underline the real unity:

- Inefficient installations are stimulated to undertake action without uncertainties about the incentive, the amount of allowances is related to the realised production level.
- Closure of obsolete plants and shifting production to efficient new or existing plants is clearly stimulated.
- CHP gets the additional incentive to enable fast growth.
- Co-firing of biomass, carbon sequestration and clean coal get the certainty of reward.
- The development and implementation of innovative technologies get the support as requested in the Directive. Innovative winners of market share are not hindered.

The PSR approach is fit for purpose; it stimulates innovation and guarantees a level playing field and free competition. In line with the "clean, clever and competitive" approach adopted by the European Council, frontrunners are rewarded and a prosperous economy and at the same time a healthy environment are favoured.

In order to achieve the real unity of the three basic principles, allowances are coupled to production requires ex-post, already partly applied in the German allocation rules. PSR with ex-post creates the same unity of principles as auctioning. It is in fact partial auctioning.

[27] For example in Denmark and the Netherlands the penetration of CHP (Combined Heat & Power) is around 40% and well ahead of the average penetration in the EU (around 10%) and the EU target of 18%. Granting more allowances as from 2008 means for such Member States higher cost as anticipated currently (partly compensated with higher corporate tax) and hence economic frictions.

V Extension of the trading scheme / post 2012 policy

The effective approach ‘PSR’ will also be essential to attract new participants to the scheme, such as Norway, Canada, Japan and South Korea. This is also valid for the development of a post 2012 policy when USA, China, India and Brazil need to be involved.

V.1 Sector approach

It is recommended that all stakeholders undertake to apply the same approach and hence the same PSR for similar processes worldwide. From the viewpoint of industrial investors it makes no difference whatsoever to the effect on climate change whether a new plant is built in country A or B.

Under a sector approach nations will be unburdened of the responsibility to achieve environmental results for involved sectors. Initiatives from industry leaders and associations can accelerate the development of this approach.

V.2 Transition regime

The Chinese economy shows a tremendous growth at the moment. For new plants the newest technologies are applied mostly. Nevertheless, in China, India and other countries many older plants still exist with a rather low efficiency. Next to or alternative to development funds as discussed in the previous chapter, a transition regime as mentioned can be considered.

The concept of transition regime is summarised again as it needs political decisions:

- **Older plants of a certain vintage fall under the transition regime**
    - For example plants built before 1975
- **The transition regime is limited to a certain period**
    - For example 7 or 10 years to enable investments or replacement by new installations
    - The transition period can also be linked to plant vintage
- **The PSR of each plant starts with its own efficiency in year 1**
- **At the end of the transition period plants must meet the general PSR**
- **During the transition period the PSR is the intermediate between the own efficiency in the 1st year and the general PSR at the end of the period**
    - PSR = the straight line between own efficiency and general PSR

The general PSR at the end of the transition period may change as PSRs can be adapted. The 1st point of the straight line – the own efficiency – is fixed. This is a stimulus for producers to act as fast as possible. Even if they are less efficient than the general PSR they can become seller of allowances during the transition period.

A transition regime requires several choices, which are political decisions (which plants fall under the regime, how long is the transition period).

Requiring absolute targets for fast-developing nations can be regarded as irresponsible behaviour of governments, although advocates of this approach have best intentions.

Therefore, adopting a sector approach with efficiency as the denominator – including the consideration of development funds and/or a transition regime to mitigate sunk costs – may be considered as a key to achieve worldwide agreements for the combat of climate change.

VI The way forward

Key points are the limited number of products with major impact and concrete initiatives from major Member States. The way forward to start as from 2008 can be summarised as follows:

- **Data collection 2003 or 2004 by consultants to determine the PSR**
  - Electricity: emission & production data incl. heat for CHP, estimated as a 6 month's job
  - Steel: similar
  - Probably already available: cement, refineries, steamcrackers, ammonia, sugar, etc.
  - Wholly or in part, 2005 data can also be used for establishing the PSRs

- **Producers must accept: keep it simple**
  - No correction for secondary effects

- **Major countries: not waiting but taking initiative**
  - Germany, UK, Italy, France, Spain, Scandinavia
  - Benelux with benchmark experience
  - Appoint high level "champions" for main products, partly also executives with industry experience
  - Expand country by country (not wait for completeness)
  - Hire consultants for concrete jobs product by product

VII Conclusion

It is argued that a major reform is needed of the implementation of the emissions trading Directive by the Member States. A more harmonised approach is needed. This can be achieved through PSR with ex-post. This reform requires boldness because cap & trade must be abandoned as from 2008.

Introducing PSR avoids 8 years loss of progress from today and ensures compliance with:

- **Worldwide environmental integrity**
  - Lowering production and exporting emissions as escape are eliminated
  - PSR can and must take into consideration the efforts which are undertaken elsewhere in the world

- **Fitness for Purpose, Polluter-pays principle & level Playing field**
  - Three acid tests for a sustainable scheme to attract new participants such as Canada, Japan and South Korea
  - Three acid tests also to achieve global agreements for post-2012 policies with USA, China, India and so forth

- **A predictable business environment**
  - Clear stimulation of efficiency improvement & innovation
  - Full support for the Lisbon strategy in Europe ("clean, clever & competitive")
  - An imperative for global welfare in the combat of climate change and to reduce the pressure on scarce resources